The American Society of Orthodontists

First Annual Meeting, held at St. Louis, Mo., June 11th, 12th and 13th, 1901.

First Annual Meeting of the American Society of Orthodontists.

Orthodontia.—Its Outlook.*

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This morning marks another epoch in the history of science, the opening of the first meeting of the Society of Orthodontists, a society organized for the promotion and exaltation of that branch of dental science known as orthodontia, and looking to the early and complete recognition of this branch as a distinct specialty, to be taught and practiced as such.

Objects of Organization.

Doubtless it would not be inappropriate for me at this time to set forth the reasons for the organization of such a society, for unless there be good and valid reasons for its establishment, its course must be marked by an unhealthy and unprofitable existence and probably an early dissolution. On the other hand, if there be good and sufficient reasons for such a society, they should be known and recognized by the lovers of all branches of medical science and the sympathy and assistance of all enlisted, that the greatest degree of benefit may be conferred, not only to the science of orthodontia, but to humanity at large, to whose welfare all laws enacted and all societies organized owe their first duties. Hence, I shall endeavor to set forth some reasons why this organization should be

*President's Address.

founded and why I believe this meeting marks the beginning of something so grand, so noble, something destined to so elevate dentistry in general and so greatly benefit humanity that even we who are assembled here this morning do not yet dream of its full importance, though we, as founders, are most interested and our hearts beat highest in enthusiasm, anxiety and love for this branch of science and the success of this, the first meeting.

To intelligently understand the reasons for the organization of this society we must trace something of the history of orthodontia.

History of Orthodontia.

What are the conditions in which we find orthodontia and what are its relations to dentistry and science in general and humanity at large, at this time? You all know that it has been closely allied with the history of dentistry proper and that the two have been apparently closely interwoven in their unfoldings and evolution and that they have come down the centuries hand in hand together, and together have witnessed the marvelous changes and progress which science in all its branches has made.

The history of orthodontia is most interesting as well as instructive, and all who make pretensions beyond the merest smattering should be familiar with it. It will not be profitable at this time to closely follow its history, but only such phases of that history as seem to have a direct bearing on the object and importance of the formation of this society.

Of the genesis of orthodontia we know as yet nothing, but it is probably many centuries old, for malocclusion of the teeth, though undoubtedly becoming more and more prevalent, has apparently always been one of man's afflictions, and supply and demand have always had at least a theoretical relation.

From what is now known of the history of man during his evolution it is clear that he had, at various periods in the distant past, made great progress in both the arts and sciences, and it is probable that dentistry also had attained quite a degree of excellence. And indeed this is more than a theory, for the cemeteries of ages long past have revealed to us many clever specimens of bridges, crowns and other artificial substitutes for the human teeth.

What progress the ancients made in treatment for the relief of pathological conditions of the teeth, or of their malocclusion, we do not know, nor is this surprising, for the very evidence of such treatment would be perishable. Indeed, even in our own time the evidence of efforts having been made at tooth-straightening, even after the lapse of but a few months, is, as you know, sometimes difficult to detect. It is more than probable, however, that efforts towards the prevention of malocclusion in the way

of extraction must have been common quite early, for extraction to relieve crowded teeth which are erupting, would have been quite naturally the first thing to suggest itself, as it does now to the laity, and though rarely wise is, alas, far too often resorted to, even at the present time, by those whose duty it is to care for the teeth and who should resort to less harmful, far wiser and more effectual and scientific plans of treatment.

Lack of Knowledge of Orthodontia.

The written history of orthodontia, though comparatively modern, always fascinating to the real student of orthodontia, must, it would seem, have many surprises in store for him who at this date reads it for the first time, and yet these surprises are clues to a better understanding of its present condition and relation to the general practice of dentistry, and especially of its requirements, if progress and the greatest good for orthodontia is desirable. Notwithstanding the fact that dental science has made marvelous progress both in its teaching and in its practice, we are nevertheless compelled to say that the most of the teaching and the most of the practice of orthodontia has so far amounted to little more than the merest smattering. While the demand for general operations in dentistry is supplied with as high an average of skill, perhaps, as any of the branches of the arts or sciences, the same cannot be said of orthodontia, for notwithstanding the fact that malocclusion with all its baneful effects, has grown to be almost the rule instead of the exception, only the merest fraction of those needing attention are receiving it, and even such treatment as is meted out is of such a nature as to leave but little doubt in the mind of the careful investigator that more blunders are committed than successes gained, and that in a heavy percentage of cases more injury has been done to the dental apparatus as a whole than benefit conferred, to say nothing of the frequently severe tax unnecessarily inflicted upon the entire physical economy of the patient.

Notwithstanding the fact that dentistry proper and orthodontia have been apparently so intimately blended and that able and competent, even brilliant operators are to be found in nearly every city and town in the civilized world, yet the number who could pass an intelligent examination in orthodontia, or who could scientifically diagnose and meet the requirements in treatment of any but an average case and that too, quickly, easily, without unnecessary pain or protractions, is remarkably limited. In fact they might easily be counted on the fingers of one hand. The harvest indeed is plentiful, but the laborers are few. Many confess that they know nothing about it and refuse, after a few futile attempts, to have anything further to do with its practice. And strange as it may at first seem, this will be found to be especially true of many of those who rank high in knowledge and skill in operative dentistry. Another surprising phase of the

history of orthodontia is that the great mass of the literature on the subject is devoted to the description of regulating appliances, principally of those that have been devised to meet the requirements of special cases, until many thousand appliances are recorded—some of them marvels of ingenuity and skill, others absurdly complex, most unsightly, crude, and inconvenient in the extreme, as inefficient and faulty in principle as it is possible to imagine, and made to operate in direct violation to many of the true physiological requirements of tooth movement and hygienic conditions incident thereto. They are produced in ignorance and operated in ignorance and the results are familiar to you all; yet our current literature still teems with them.

In fact, so prominent are the mechanics of orthodontia in our written history that our would-be student must often reach the conclusion that "regulating appliances" and "orthodontia" are nearly synonymous in their meaning. Imagine his surprise, if he could be convinced, as I feel sure that he can, that two or, at most, three appliances of proper form are not only ample to meet the requirements of all tooth movements, but do so more easily and acceptably than any or all the rest, and that these are founded on principles extremely simple and much older than this republic, and that at most appliances should be only a minor phase of orthodontia—merely a means to an end, as the colors and brushes are to the artist and he will be amazed to learn that many phases of orthodontia, which possess an even greater importance than the mechanical are usually lost sight of entirely and are, at best, only superficially considered, as for example, the very tissue changes incident to tooth movement and their wonderful modification and development subsequent thereto and the important bearing of all this on diagnosis and prognosis.

And again, if our student of the history of orthodontia be familiar with the true requirements and great possibilities of that science, he will be amazed at the wonderful lack of breadth of knowledge that has been displayed in the efforts made for the correction of malocclusion, these efforts being nearly always limited to the attempted correction of malposed incisors and usually of the upper arch only—mere symptoms of the true condition—and often accompanied by that most pernicious practice, extraction. Think of it! Working in utter disregard of the very basis of the science—*occlusion*, and in ignorance of its mighty laws! Think of it, you who now know the wonderful interdependence of the jaws and the importance of the humblest tooth, not only in its individual arch, but in its relation to all other teeth in both arches, and indeed to the entire dental apparatus and very structure of the face! Although the teaching of this branch in our dental colleges has made considerable advancement, our student would, nevertheless, be further shocked to learn of the crude, un-

scientific methods comprising the course in many schools of dentistry. I do not believe there is another branch throughout the whole realm of science so badly taught as that of orthodontia, its teaching in many schools being truly a disgrace to the science and to pedagogy.

Then why is it that so little really good work is done in orthodontia in proportion to the opportunities and importance? Why is orthodontia in practice but a side issue to all other operations in dentistry? Why is instruction in this branch in our colleges so lamentably defective? Why are the discussions of papers on the subject in dental societies so lamentably weak, being usually confined to the discussion of peculiar forms of regulating appliances, or tedious descriptions of so-called *rare* cases, or controversies over extraction as a means of treatment, while the very principles and most important phases of the subject are rarely ever even touched upon? Why is there such a lamentable number of failures and blunders in cases treated by dentists? Why are parents so often given such erroneous advice in answer to inquiries concerning developing cases of malocclusion in their children, as, "The children are too young," or, "too old," or "let them alone and nature unaided will perform the desired cure," or "wait until all the teeth have erupted before beginning treatment," or other discouraging answers, such as prohibitory fees, etc. The situation is remarkable and unique, a great and useful science struggling for recognition, yet receiving only snubs and discouragement at the hands of most practitioners. Again I ask, why is all this true?

Orthodontia as a Separate Science.

The answer to all these questions seems to me to be plain and should, as we think, be apparent to all, even to casual investigators. It is that orthodontia is a great science by itself, with requirements in its study and practice so radically unlike that of other branches of dentistry that the two can never be profitably combined, either in study or practice. Each seriously handicaps the other and orthodontia naturally suffers most for the reason that it is wholly unlike other operations in dentistry. It is therefore least understood, least studied and made secondary alike in dental colleges, in practice and in dental societies. Hence it is not unlikely to follow that in proportion as a dentist is successful in other operations of dentistry he will naturally be less successful in those of orthodontia, for in that same proportion he will have less inclination, less time, and less energy to devote to it. Few would think it advisable to combine the practice of rhinology with that of dentistry, and yet we believe the two could be far more easily, profitably and successfully combined than can orthodontia and dentistry proper. The fact is, orthodontia deals almost wholly with different tissues, principles and art problems from those treated in ordinary dentistry and is extremely ex-

acting in its requirements, necessitating peculiar talent, energy, fitness and devotion to certain lines of study which are as unlike those of other branches of dentistry as are the instruments best adapted to the performance of operations in each.

Another most important reason is that the science of dentistry has grown to such proportions as to embrace in its study so large a field that any one who attempts to master it all must be regarded as a mere smatterer. In fact it needs no argument to prove that all progress in the different branches of dentistry is in reality being made largely by those who are specializing.

The ultimate separation of orthodontia from dentistry proper is natural and inevitable and the sooner it is encouraged and becomes firmly established, the better it will be for both and infinitely better for humanity at large. Orthodontia offers ample opportunities for the brightest minds. Let each student of dentistry, after having acquired a thorough knowledge of the fundamental principles of the science, select such lines as are best suited to his aptitude and liking and confine his energies to his selection and the result cannot fail to be vastly more beneficial than the plan now followed. As yet there have been only a few who have had the courage to completely specialize the practice of orthodontia, but the result of the efforts of even those few has been truly remarkable. Orthodontia has been revolutionized, and we would ask those who may doubt the practicability of this specialization of orthodontia to but reflect on the marvelous advancement which has been made in the various branches of medicine through specialization, not to mention the growth of nearly every other branch of science and art accomplished by the same power. Indeed this is the very age of specialization, and was there ever such an age of progress? Wise is he who recognizes the natural and resistless power of specialization, and narrow indeed must be he who is blind to its demands and attempts to resist its might.

To hope that all this may be brought about at once, or even in several years, would be expecting too much. Great and radical changes must be wrought slowly. We must remember that each specialty in medicine has developed slowly and has become firmly established only after a considerable lapse of time and after many trials—ofttimes in spite of the keenest opposition—yet we can point with pride to the career of the late Dr. Thomas Rumbold of this city, whom several of us were proud to have the honor of calling friend. He was the father of rhinology and lived to see it firmly established as an indispensable specialty in medicine.

So we must work patiently and wait and believe that orthodontia, so replete with possibilities for improving the health and the happiness of orally deformed humanity, and for uplifting the highest phase of art, or

that of improving the lines of beauty and that too not applied to the cold, unresponsive lines of marble, clay, or on canvas, but to the living, divinely patterned human face, will and must be a firmly established and useful specialty of dental science, and if this is inevitable, as I believe it is, then it is fitting and proper that this society should be established, for our best efforts can only yield the best fruit in strong, earnest, sincere, concerted action.

We certainly have much to encourage us. In the effort to found this society many have been the encouraging letters received from earnest workers in this specialty, both in this country and in Europe, some of which will be read later. The time seems ripe for this organization. There has been criticism, it is true, regarding the organization of this society, but only from two or three sources—indeed I might more properly say that they were more in the nature of suggestions, to the effect that it might be better to confine our energies to the section of orthodontia of our National Dental Association. We will not here attempt to analyze the objections to this plan. We will only state that what might seem the most convincing reason in opposition to this plan is the same that has already been offered to the teaching and practice of orthodontia when combined with dentistry—in combination it must ever be made secondary and greatly handicapped, even in our National Association, and its history in that society certainly confirms this statement.

In the deliberations of this society now and hereafter let us not forget the great debt we owe to the many noble men who have worked so earnestly in this, our chosen field, and who, although often seriously hindered, have developed orthodontia so that it is possible for us to establish this organization. Let me mention with tender reverence the names of but a few: Fauchard, Schange, Fox, Harris, Wescott, Magill, and of those who are still with us, Kingsley, Baker, Guilford, Brady, Case, Matteson, Ottolengui, Jackson, Farrar and Goddard, the pictures of most of whom I now take pleasure in placing upon the screen.

In conclusion let me earnestly try to impress upon you that in proportion as we are sincere, broad, liberal, honest, earnest and studious will our efforts be successful and the prosperity of this society be insured; and on the contrary, in proportion as narrowness, selfishness and that bane and cause of dry rot of most societies—politics, be permitted to enter here, so will the efficacy of this society be blighted.

Disproportionate Development of the Upper and the Lower Jaws. A Method of Determining their Supra or Sub-Normality.

By W. O. Talbot, D.D.S., Biloxi, Miss.

Among the most conspicuous deformities about the human face are those that are due to the disproportion in the size of the upper and the lower jaws. We have irregularities and malocclusions of the teeth, due to their several causes, and when such abnormalities are confined to the disarrangement of the teeth in their respective arches, or to the simple mesial or distal occlusion of the lower jaw, such disarrangement is scarcely noticeable by the casual observer except when the lips are separated.

The average dentist may look upon such mouths with some degree of consideration, and picture in his mind the improvement in the expression of such persons, were their teeth properly arranged in the arches and the arches correctly adjusted to each other. But that which appeals even to the casual observer, which calls forth deep consideration from the average dentist, and which actually grates upon the feelings of the æsthetic who has studied and does properly appreciate the harmony in facial expression, is the over-development, or lack of development of either the upper or the lower jaws. This condition is disfiguring and often becomes embarrassing to the patient, especially if it be the case of a young lady.

Every dentist who practices orthodontia at all has such cases presented to him for treatment. The most important step, as in all disorders, is a correct diagnosis which must be reached if the treatment is to be successful. If there is a disproportion in the size of the jaws, that is easily recognized by the orthodontist, and before placing an appliance or fully determining a course of treatment he must answer these questions in his own mind: "Is the upper jaw too small, or the lower jaw too large?" and vice versa: "How can this be determined accurately?" To answer these questions is the purpose of this paper.

Since it has long been known that the length of certain bones of the body bear a definite relation to the length of the whole body of man, it is reasonable to conclude that all the bones of a man's body bear some definite relation to each other in size and length. The variation from this definite proportion serves to give variety to the stature and form of man. In searching for some rule of proportion in the size of the upper and the

lower jaws, together with the other bones of the face that have to do with the facial outline and give it expression, the writer, after having examined some twenty-five cases including the three classes of malocclusion given by Dr. Angle, has reached the following conclusions:

Rules for Diagnosis.

First, when the teeth are in normal occlusion and the "line of harmony" (Dr. Angle) applies, there are three points of the face that are in the circumference of a circle described by the compass with the condyle of the lower jaw as the center. These three points are: the point of the chin, the tip of the nose, and the frontal eminence about one inch above the line of the eyebrows.

Second, when the upper teeth are in a normal position and the jaw normally developed, the point between the cutting edge of the upper central incisors and the concavity of the nasal bones on the ridge of the nose (between the eyes) are equally distant from the condyle of the lower jaw, measured with the compass.

Third, when measurement I applies and II does not, the deformity is in the upper jaw. If overdevelopment, the point of the compass in measurement II will not reach the edge of the central incisors. If the upper jaw is not sufficiently developed, allowing the teeth to crowd, the point of the compass will pass beyond the incisors.

Fourth, when measurement II applies and I does not, the deformity is in the lower jaw. If overdeveloped, when the point of the compass is placed on the point of the chin (the other on the condyle), and a circle described, the point will miss the nose and go high up on the forehead, and in extreme cases will pass over the forehead. If the lower jaw is subnormally developed, the point of the compass when adjusted to touch the tip of the nose and the frontal eminence will pass over the chin.

The conditions set forth in measurement IV might occur to a slight degree in a case of simple mesial or distal occlusion, but that could be easily determined by the regularity of the teeth in the arches.

In measurement I, the condyle, the point of the chin, and the frontal eminence, where the arc of the circle strikes the latter, form an equilateral triangle. A special compass should be made for this work, with rounded points and a brace scaled with millimeters, by the use of which accurate measurements could be made and records kept.

The conclusions are not given as absolute measurements that apply to inanimate things, but as general rules that apply to that which is animate, subject to the variations of a human body that lives and grows according to its environment.

It is hoped that these rules may be of some service to the orthodontist who finds himself in doubt as to the true proportion in the size

of the upper and the lower jaws of any case he may have to treat, in recompense for which I would ask that all who have occasion to use such rules would put them to the test, and make a record of their findings, that those who are interested in the subject of orthodontia may be benefited thereby.

Greeting.

By Dr. W. Booth Pearsall, Dublin, Ireland.

My kind friend, Dr. Edward H. Angle, has given me the opportunity of taking part in his "*cead mille failthe*" (a hundred thousand welcomes) that has brought the first congress of orthodontia to St. Louis. I know of the great skill and enthusiasm that has assembled so many students of orthodontia together to confer upon the possibilities of this comparatively young development of dental science. I therefore send you my felicitations on such an auspicious occasion through Dr. Angle, as I cannot be present with you in person. I know my hearty good wishes will be received by you all in the same cordial spirit with which I tender them, for I have always met with great personal kindness and hospitality in the United States from my brethren, whenever I have visited amongst them.

This is the first congress that has been held for the consideration and development of the science of orthodontia. It is an opportunity not only for good words and congratulations, but to be used for consolidating and developing our ideas on the possibilities of great improvements in technique and research, likely to benefit both patients and practitioners. The definition of correct principles and methods—the careful classification and record of typical cases—the invention and development of scientific and accurate diagrams showing the movements of the human teeth, are all worthy objects for conference. I regard as of great importance the collection of all useful anatomical facts, whether we gather them from medical or surgical authors, from the anatomical departments of the many medical schools throughout the world, as well as the observations of anatomists whose writings have not yet obtained currency in our dental books.

Importance of Collecting Scientific Data.

There is much to be learned in this direction, despite the success of the empirical methods of some prominent orthodontists. It is to be doubted if any general progress can take place amongst practitioners, till such a foundation can be laid from anatomical sources, as will be strong enough on which to erect a structure to hold within its walls all the essential facts that are needed for the comprehensive knowledge of this important subject.

The practitioners who study orthodontia by the scientific method are few in number. When I use the word scientific, I mean that patient investigation and record of truths taken from reliable sources, and especially from anatomical preparations in museums. Were a small number of really earnest men to devote a little time to such investigations, and by means of casts, diagrams and photographs place on record well selected examples of malocclusion and their causes, as shown by anatomical preparations, our knowledge would in a few short years emerge from the semi-darkness so many of us have too long groped in.

An intelligent method of observation and study would bring to light valuable facts that would largely increase our knowledge, which should be used in dental schools and by practitioners throughout the world. I would earnestly advocate the election of suitable observers for such a collective investigation of crania. By their aid and discrimination, casts, preparations, diagrams and photographs could be recorded and published by a body interested in this subject. There is, I am convinced, a mine of information scattered throughout the world that only needs intelligent and patient working, not only to establish scientific truths, but to destroy much of the ignorance and jumping at conclusions many of us know to exist. I need not mention names, but we have much to do in the English-speaking world alone to correct the hasty judgments and faulty teaching of several practitioners, for we cannot call them scientific men, who have confused and embarrassed the minds of ordinary practitioners and students with regard to the value of the sixth year molar, for instance, and their views as to the prevalence and causation of types of irregularities in the position of the human teeth need much careful investigation from the scientific anatomical standpoint. Great harm has been done in practice by so-called "authoritative teaching" which has "jumped at conclusions" with baneful results in many mouths, as seen by tilted twelfth year molars, while the diastema caused by the extraction of the sixth year molars leaves the patient's condition, after months of painful treatment, worse than when the blundering methods relied upon for improvement were begun.

Museum Collections for Colleges.

I throw out these suggestions in the hope that a serious collective attempt will be made to investigate in this accurate manner the causes that underlie the malposition of so many teeth as seen in the mouths of the civilized races of mankind. Were accurate methods of study and record designed and formulated so that intelligent observers could take part in such a great work, much progress is possible by the patient record and publication of accurately ascertained facts. Casts, preparations, diagrams and photographs of perennial value could, by such effort, be placed in the museum of every dental school. By interchange of examples museums would have specimens by which they could correct the misapprehensions that may arise from merely *reading* about things instead of seeing them.

In 1893, at the meeting of the British Dental Association in Birmingham, I attempted to effect an improvement in teaching appliances and specimens by proposing the formation of an association of members engaged in dental teaching for collecting casts and specimens of educational interest, so that they could be selected and duplicated for school or other museums. Had my proposals been acted upon, we would now have in Great Britain and Ireland some valuable teaching or school museums. Such a movement would, I have no doubt, have been carried out in the United States, as the technic work has been carried out. If I may judge from a careful inspection of the few dental museums I have seen in Washington, Harvard, Cleveland, Buffalo, and in Chicago, such an organized and scientific work is badly needed. The meetings of the National School of Dental Technics would seem to me a suitable opportunity of exhibiting standard casts and preparations for approval, with a view of improving the teaching, or record of valuable facts. In such a body you have ready to hand an intelligent and discriminating society of experts in dental teaching in many matters of detail, whose approval and criticism, together with the help of the collective investigators I have proposed, would be accepted by many of us as authoritative.

Investigations of truth is attained by many roads, and if we make use of the most helpful and direct ways to advance we not only benefit the sufferers from loss of function caused by dental deformity, but we also advance ourselves in skill.

Tooth Forms.

We should begin, for instance, by formulating an anatomical standard of the forms of human teeth. It is very remarkable that although the printed anatomical descriptions and characteristics of the human teeth resemble each other, in different books, a close inspection of the illustrations given in them will show points of great divergence, both in the crowns and

roots of teeth, whether we study them in Hunter, in Fox, in Bell, in Tomes, in Trosseau or in Carabelli.

An independent investigation of my own and some correspondence with Mr. Chas. S. Tomes, the late Andrew Wilson of Edinburgh, and Mr. John Humphreys, who has worked with Professor Windle in Birmingham, will show, it is evident, that each of these investigators has found his own ideal. Illustrations in American text books show similar divergences, whether you wish to study normal or abnormal teeth.

Nomenclature.

We also need a more accurate nomenclature—one that will be acceptable to all English speaking dentists, describing the same conditions. We ought to be able to get rid of such barbarous terms as V arches, "saddle back arches," "jumbled arches" and that hateful term "anterior superior protrusion." Anatomists have for several years past confined the term maxilla to the upper jaw and avoided confusion by calling the inferior maxilla the mandible. We should follow up this more exact and reasonable view, as such a change would simplify matters and remove a constant cause of blundering.

Having taken advantage of Dr. Edward H. Angle's kindness to lay some of my suggestions before you, I wish to attract your attention to the views of the late Dr. Paul Albrecht, Professor of Anatomy at Brussels and at Hamburg, with regard to his theory of the number of the intermaxillary bones. Albrecht's work seems, so far as I can discover, to be unknown to dentists, although his theory is of the greatest interest to them. We have all of us observed that greater disturbances in the position of human teeth take place in the incisive and canine region of the maxilla than in any other part of this region of the mouth. His theory should be known to you all, as it has, in my opinion, an important bearing on much that needs correction in treatment. The novelty of his views and the careful research he applied for years to this important subject cannot fail to be of interest to you all. Strange to say, I have never seen his name nor his theory mentioned in any dental book, but, nevertheless, his theory is of interest to us all, whether we practice orthodontia, dentistry, or oral surgery. My daughter has made a translation of this interesting paper from the French, which I have supervised so as to avoid any mistakes from her lack of technical knowledge of the subject. The translation may not be perfect, but we have endeavored to make Dr. Albrecht's meaning quite clear. I have drawn his diagrams so that they can be readily studied at the places where they can be compared with the text of this original and able author.

It will, I am sure, be of interest to many to learn that the great German poet, Goethe, worked at this subject of cleft palate so successfully

that his views were held by many till Dr. Paul Albrecht brought forward another theory based upon careful study of actual specimens in several anatomical museums.

I have been familiar with Albrecht's views for several years and I cannot help thinking that some of the variations in the incisive and canine regions of the maxilla may be due to the unequal growth of the four intermaxillary bones described by him. I may add that I have seen skulls showing Albrecht's sutures, and I shall take an opportunity of photographing them for publication, if my suggestions on scientific research now offered to your congress should bear fruit in the formation of a collective body of observers throughout the world.

The Laws of Articulation in Orthodontia.

By Herbert A. Pullen, D.M.D., Buffalo, N. Y.

The normal masticatory apparatus of man, with the attachment muscles, is a very striking example of perfection in design and purpose. from the standpoint of geometry, physics and mechanics.

The bilateral arrangement of muscles, the shape of the arches, of the teeth, and their harmonious relation to each other, the form, size and position of the teeth with their cusps interdigitating for mutual support, the upward curve of the ramus, and the relation of the occlusal planes, all serve the purpose of increasing the efficiency of the organs of mastication, by providing the means, whereby a co-ordination and equilibrium of forces are secured, which are essential for the preservation and function of the organs themselves, as well as for economy of force, and the production of lines of beauty not possible in any other arrangement.

The laws of normal occlusion which have been so extensively elaborated by Dr. Angle, present to our minds the best description that has been published of the normal relations of the teeth in both arches when the jaws are in the position of rest, the mouth being closed.

Believing that a study of the relations between the two arches of teeth during the movements of the lower jaw dependent on its articulation at the Glenoid fossa, will be conducive to a more comprehensive knowledge of the diagnosis and treatment of certain forms of irregularities presenting in practice with more or less frequency, I shall undertake to record a few of the practical points that have been observed relating to the application of the laws of articulation to the correction of irregular teeth.

Occlusion and Articulation.

It is first necessary to emphasize the distinction between the terms occlusion and articulation, which is approved by the majority of the best writers in the dental profession.

Occlusion is the mere coming together of the teeth, cusps to sulci, in a position of rest.

Articulation is the relation between the teeth of the upper and lower jaws during the lateral and protrusive excursions of the mandible, dependent on its universal articulation at the Glenoid fossa.

Occlusion represents the static, and articulation, the dynamic relation between the jaws.

Occlusion is passive—articulation is *active*.

Dr. Snow divides articulation into three distinct stages: 1. Prehension. 2. Attrition. 3. Occlusion.

Occlusion then may be recognized as one of the *phases* of articulation.

The very fact that occlusion represents a static relationship between the jaws makes it obvious that it should be designated as the basis from which to diagnose and treat malocclusion.

In occlusion the lines of force are constant in their direction. In articulation they are ever changing, varying as the relationship between the jaws.

The influence of these forces in normal occlusion tend to preserve the continuity of the normal relationship. In malocculsion these forces tend to confirm the condition and often to intensify it.

It is also evident that a malocclusion necessarily creates a malarticulation, and the latter increases in degree as does the former.

Let us examine for a moment the jaws in normal articulation, moving the lower jaw to the left from the position of occlusion: "The right condyle moves forward and downward in the Glenoid cavity one-eighth of an inch, when at its farthest limit, causing the outer and inner cusps of the upper teeth from the centrals to the last molar, to touch the outer and inner, or buccal and lingual cusps of the lower on same side—the left; and on the opposite side—the right—we find only the inner cusps of the bicuspids and molars of the upper, to come in contact with the outer of the lower, and the right central to the cuspid do not touch."

In moving the lower jaw to the right these positions are just reversed.

Again, if the lower jaw is moved directly forward from the position of occlusion, until the incisors touch edge to edge, the buccal and lingual cusps of upper second molars touch the buccal and lingual cusps of lower second molars.

In order that this articulation of cusps in the above movement may take place, the overbite must not only be proportionate in depth to the depth of the grooves in bicuspids and molars, but also the curvature upward of the ramus must be in the same proportion.

The depth of the cusps in the upper first bicuspids corresponds almost exactly with the depth of the overbite, the cusps diminishing in depth from first bicuspids to last molar.

The necessity for the touching of so many teeth during articulation is evident when we recall that the muscles of the jaws should act equally on both sides, even though but one side is in use at one time, the other side touching to balance the forces at work on the opposite side.

Such is the action of the complicated machinery with which Nature has endowed us for the mastication of our food.

Dr. Bonwill said: "It is mechanical law, and that of motion, to obtain a certain result for the perpetuation of the organs themselves, but the life of the whole organization, and the grooves, fissures and cusps are so arranged . . . . that where each is in its normal position in the jaws all surfaces wear alike, and the shapes are kept in harmony."

Any interference with this arrangement, as extraction, not only limits functional power, but also renders some of the teeth imperfect from overuse, or malocclusion and malarticulation.

Quoting again from Dr. Bonwill: "It will enable you to see from this perfect articulation . . . . that the study of these laws will enlighten you in the true science of correcting irregularites. When plaster casts are made of both jaws and placed in this articulator, you will see, as you never did before, how ignorant you had been and how criminal your treatment in such cases."

Surely, then, we must not correct irregularities of the teeth with an eye only to occlusion. If we do, we shall miss many important points bearing upon the success and permanence of our work.

It is not necessary to articulate the models of every case of malocclusion in practice, in order to observe the workings of these laws, for often they can be best observed in the mouth of the patient himself, and a conclusion drawn as to their harmonious working or the reverse, as may be discovered.

During regulation, any inharmony of articulation is usually manifest, and we can many times arrest it before any serious interference has taken place.

The operation of "jumping the bite" would be an impossibility were it not true that the lower jaw has the power of prehension.

In cases of protrusion of the first division, second class (Angle) when it is necessary to shorten the upper incisors by depression, by try-

ing the prehensile movement, we can tell when they are sufficiently depressed for their protection from the protrusive force of the lower incisors during this movement.

No cusp of any tooth should be allowed to remain so long that it alone touches during any period of the movement of mastication; for the tooth would soon be moved out of its position by the abnormal articulation, or it would become diseased through overuse.

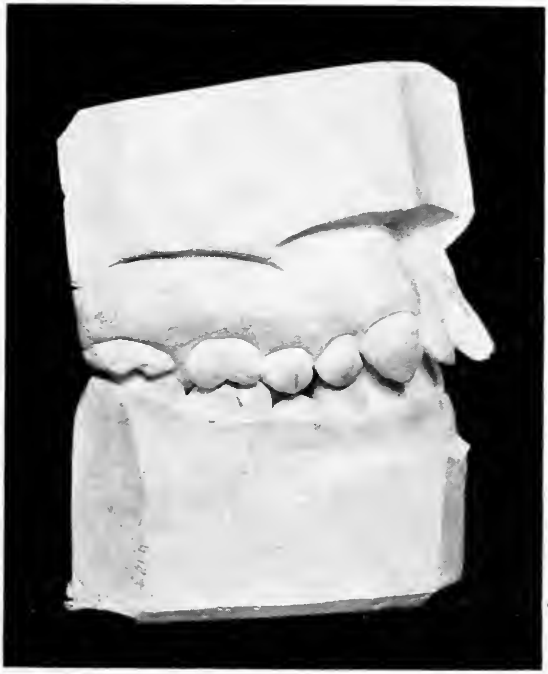

Fig. 1.

Especially noticeable here is the prominence of the cusp of the upper cuspid after retraction in cases of this class. The harmonizing of the articulation is secured by shortening of the cusp sufficiently.

Again, in this class of cases, the lower incisors are almost invariably in supra-occlusion, and if this lengthened condition is allowed to remain after the protrusion of the upper teeth has been reduced, the condition will most surely return to a greater or less extent, due to the pressure

outward of the lower incisors against the upper during the outward and forward excursions of the jaw.

Besides depressing the upper incisors in their sockets in these cases, it is often necessary to depress the lower incisors as well as to elevate the lower bicuspids and molars at the same time, in order to harmonize the articulating plane of the lower teeth.

Fig. 2.

The Law Illustrated by Practical Cases.

The accompanying illustrations represent the models of a lipbiter of the first class, placed in the Bonwill articulator for observance of the laws of articulation. Fig. 1 represents the models with the teeth in the position of occlusion, showing the protrusion of the upper incisors.

Fig. 2 represents the same models during the extreme stage of the movement of prehension, and illustrates the effect of the outward pressure of the lengthened lower incisors against the upper incisors, increasing their protrusion to the exact limit of the prehensile movement of the lower jaw.

I think this illustration is a very fair proof of the law above mentioned, viz.: the depth of the overbite being governed by the length of the cusps in bicuspids.

In this case the lengthened incisors, above and below, would tend to create a greater overbite than the depth of cusps in the bicuspids and molars would allow, but the forces of articulation have secured the proper overbite at the expense of the upper incisors which presented the least resistance in its accomplishment.

Another proof of this law may be noticed in the mouths of patients, who have what is called the "end to end" bite, in which case all of the

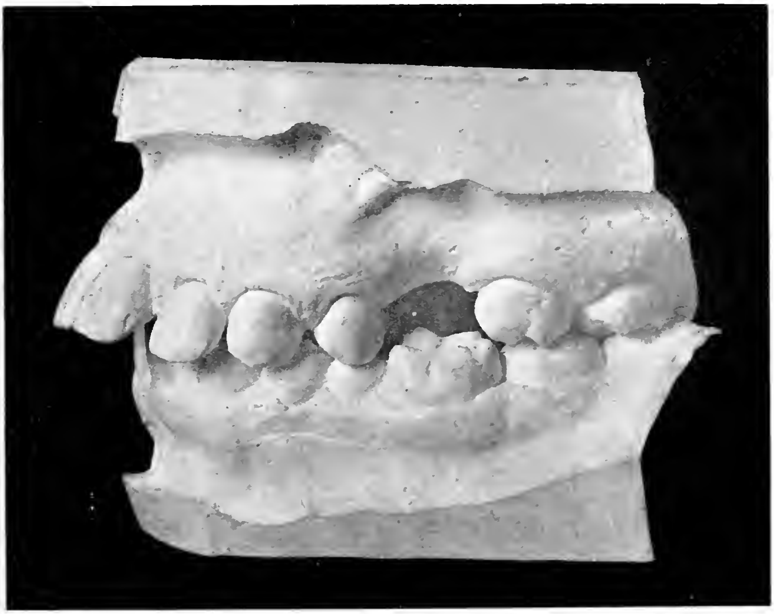

Fig. 3.

teeth of the upper jaw occlude end to end with lower teeth, there being no overbite at the incisors, and the bicuspids and molars being without cusps, also having no overbite. The laws of articulation thus often prevail at the expense of the cusps of the teeth.

The figures 3 and 4 illustrate the same forces of articulation at work as in the first picture exhibited, although the case is one from another class of malocclusion, the lower jaw being distal to normal, being Class 2, first division (Angle).

If the fixed laws of normal occlusion demonstrate the evils of extraction, even more are they noticeable in the crippling of the articulation. Nature can patch up an occlusion rendered faulty through extraction to

some extent, but it is very difficult for her to patch up the articulation in such a case.

The possibility of the restoration of faulty articulating planes belongs to a practically new field, and is deserving of our study, for until we can accomplish this, our results will never be perfect.

The complete restoration of articulating planes is not within the limits of the methods of operation at the present time, except in a few cases, uncomplicated by extraction. Nature of course does the best she can in securing harmony of cusps and inclined planes during articulation, after the teeth have been placed in their correct positions in the arch.

Fig. 4.

To the student of these laws, the gag-plate is an impossibility, as well as is every other appliance which interferes so seriously with occlusion and articulation.

In the application of appliances for retention, one must take care that they do not interfere with the movements of articulation.

I believe with Dr. Bonwill in a premeditated type—that "the incisors show a definite fixedness of purpose to arrange themselves after their typal shape and to form the overbite at a given depth, for the accommodation of the bicuspids and molars, which appear soon after, having cusps of a definite length, so that the law of articulation, which has

been premeditated to a certain typal shape and construction, may be carried out."

By measuring the depth of the cusps in the bicuspids in a case of malocclusion in which the upper incisors are in infra-occlusion, we know the approximate overbite of the incisors, and can base our operations for treatment accordingly for the restoration of the normal overbite.

A study of the construction of the arches of teeth upon the equilateral triangle will give us an idea of the definite basis from which to work, e. g., with a definite form of the arch in mind, the changes necessary to make in the shape of expansion arches will be indicated by any deviation from the normal type as well as the degree of expansion or contraction in a given case.

In conclusion, let me repeat that the laws of articulation are important aids to us in diagnosis, prognosis, and treatment of malocclusion, to appreciate which we should note their working in each case presenting, not only with the view of gaining personally by so doing, but also with the possibility of discovering new practical points tending to progress in our chosen specialty, along lines which promise much, and toward which I can only point the way.

Some Points Concerning Occlusion.

By William J. Brady, D.D.S., Iowa City, Iowa.

There is nothing more constantly before the dental practitioner than the consideration of the occlusion of the teeth. It is a factor to be reckoned with in nearly all operative procedures, especially those that involve any restoration of the contour of the teeth, and it is one of the vital points in every prosthetic operation, including the vast sphere of crown and bridge work. Scarcely an operation is performed within the fields mentioned that is not in some way materially influenced by the occlusion of the teeth, and yet nothing is more constantly overlooked and disregarded.

In the great and growing realm of orthodontia, the occlusion of the teeth is the central figure around which all other portions of the subject are grouped, and to which they are vitally connected. It is the very basis of the subject and is worthy of our deepest study, for an understanding of it is absolutely necessary to any lasting success.

Any other foundation for our specialty must prove a quicksand in the end, as has been abundantly proved by the earlier practice in ortho-

dontia, which was built upon the basis of mere appliances and the mechanical details of moving malposed teeth, rather than upon the reasons for changing (I will not say correcting) the positions of the teeth in question.

It was not until the occlusion of the teeth was fixed upon as the basal principle in orthodontia that the subject was placed upon a basis where any systematic and orderly plan of study and treatment was possible. With this basis established, however, means were provided for a definite and intelligible classification and diagnosis, and for equally as definite and intelligent plans of treatment, and orthodontia was removed from chaos and confusion to order and precision.

I do not unduly eulogize the discoverer of this great basal principle of our specialty when I say that he must be recognized as the father of modern practice in orthodontia. Angle's classification of malocclusion is to orthodontia what grammar is to a language, and it will be a monument to the author long after his bones have crumbled to dust, and Mother Earth has claimed him for her very own.

The idea of making occlusion of the teeth the great starting point in the study of orthodontia is so comparatively recent, and so absurdly simple, that the majority of the profession have as yet not grasped its meaning, and many even do not know of the discovery of this great principle. Even some of those who have given attention to orthodontia do not yet realize what it means, and others yet will not, even though they might, but prefer to remain in the dim light of the ancient tallow candle of mere appliances, and surrounded by the confusion of continued experiment and never-ending invention.

Let us hope that the time will soon come when all who give attention to orthodontia will grasp the full meaning of occlusion of the teeth, and that the time and energy now wasted in considering appliances (and most of them "back numbers" at that) may be turned to better service and to some lasting good.

While the occlusion of the teeth has been and still is disregarded in a vast majority of operations where it should be most carefully observed, and while most practitioners are indifferent to its importance, yet it has been the study of some of the great minds that occasionally illuminate the dental firmament.

It is not necessary to set forth in detail the writers and what they have said upon this subject in order to discuss a few special points. The present writer does not claim any originality or new discovery in the material presented, unless it be a better arrangement and clearer presentation of some facts. This paper will not attempt to consider more than some of the mechanics concerned during the operation of occlusion, and the

exact form of the dental arch resulting from the same, when Nature's plans are not counteracted or disturbed.

Occlusion.

Occlusion of the teeth means more than merely the striking together of the upper and the lower teeth. The subject also includes the relative position of the lower jaw to the upper and the peculiar form of movement that the lower jaw undergoes during the process of mastication, together with the mechanics of the forces operating during this movement, which compel a dental arch of a certain definite form to permit of usefulness.

A study of occlusion also includes consideration of the form and size of the two jaws and the superimposed alveolar processes, together with the anatomical relations of the tempero-maxillary articulation. It includes the study of the effect of nasal or pharyngeal troubles upon the development of the jaws and the shape of the arch, and coming down to the teeth themselves includes the time and manner of their development, absorption and eruption, with the very great influence that the lips, cheeks and tongue exert over their assuming their proper places in the dental arch following eruption, as well as the mere accidents of dentition that affect their positions. Going still further it includes a study of the forms of the individual teeth, with their relative sizes and the shape and number of their ridges, grooves, sulci and cusps. Last, but not least, occlusion involves a most careful consideration of the occlusal planes of the teeth, and a most particular study of exactly how and where each and every cusp, ridge and surface occludes with the opposing teeth, not only during a state of rest but during the movements of the jaw as well.

Articulation.

It has been argued that the old term articulation was more comprehensive than the term occlusion, inasmuch as it meant the gliding of surfaces over each other. But the term occlusion has been enlarged to mean all ever meant by articulation, and a great deal besides, and being a more modern term, which has already entered into the nomenclature of dentistry in combination with other words, it seems well to drop the old articulation and use occlusion in its stead entirely. Terms mean just what we make them mean any way, so why not once for all settle that we mean the entire subject in its broadest sense when we say occlusion?

Dental Arch.

Much has been said about the shape of a perfectly formed dental arch, and it has varied from the simple description of the old farmer that "it was shaped like a hoss shoe, toe for'ard," up to a presentation of complex geometrical figures so complicated as to be past all understanding by any ordinary person.

This much is settled, however, the perfect dental arch has a certain definite form not difficult to understand, and this form is largely produced by the mechanics of the movement of the lower jaw. Both upper and lower being largely dependent upon each other as regards form, the ideal arch of one jaw has its ideal counterpart in the other, and both follow the same geometrical form.

The late W. G. A. Bonwill was undoubtedly the pioneer observer and writer regarding the occlusion of the teeth, but unfortunately he was never fully understood nor appreciated. His observations are the foundation of these notes, although they differ slightly upon some points.

Bonwill long ago established the truth that the lower jaw comprises an equilateral triangle from condyle to condyle and a point between the lower central incisors, and upon the labial surface thereof. (Fig. 1.) This has often been shown before, but the corresponding triangle of the upper jaw has never been illustrated to my knowledge. In this the points of the triangle are located near the centers of the glenoid fossæ, and upon the

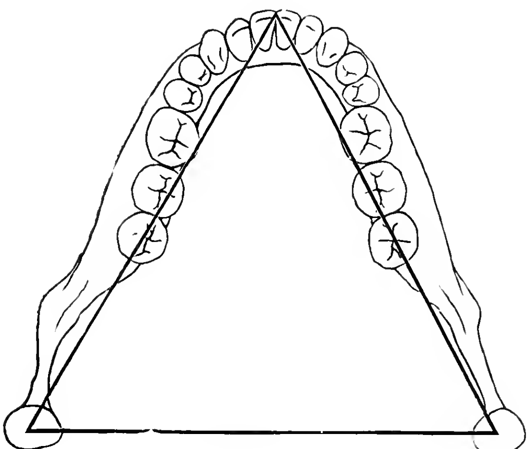

Fig. 1.

lingual surfaces of the upper central incisors, and at a point about one-third the distance from their incisal edges to their cervical margins. (Fig. 2.)

This observation regarding the triangle found in the jaw of man was not made hastily, but was settled upon after the measurement of very many skulls of different races, of both ancient and modern time. While there are of course some slight variations to this condition, yet it is the rule in an overwhelming majority of cases, and any one doubting its accuracy will soon be convinced upon a little private investigation.

Movement of Lower Jaw.

The next point to consider is the movement of the lower jaw. The animal man has three distinct movements to his mandible: the open and shut or hingelike movement, the forward and back or antero-posterior movement (the incising movement), and the side to side or lateral movement. There may also be a combination of the antero-posterior and lateral movements, resulting in a rotary sort of gyration, but this is only occasional, and no mastication or other service is performed by it, so it may be left out of the question altogether.

Of these movements of the jaw, the lateral is the one performing the greatest service in mastication, and the one having the greatest influence upon the shape of the arch. It is a complicated movement, and one which must always be considered in orthodontia. Its influence is great either in assisting us or in undoing our work, and woe to the orthodontist who fails to reckon with it.

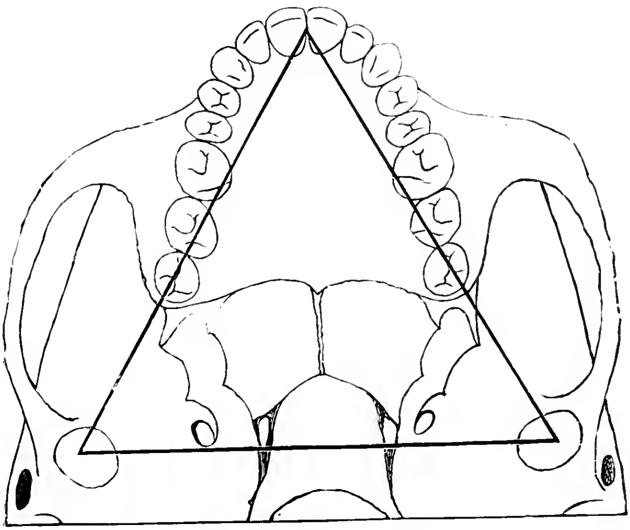

Fig. 2.

It might be said also that it is just as important to the prosthodontist, and that he of all men ignores it the most. Not a crown nor piece of bridge work, not a denture of any kind, large or small, is made but this movement of the jaw should be almost the chief feature considered, and yet we daily find it the general practice to use articulators that give only the straight open and shut movement, making consideration of the lateral movement of the jaw an utter impossibility. All this, too, in face of the fact that the anatomical articulator of Bonwill has been before the dental practitioner for over forty years.

There is no excuse for ignoring the lateral movement of the jaw with this instrument to represent it. It might be added that the Bonwill articulator is an absolute necessity to the orthodontist, and should be used in nearly every case.

When the lower jaw moves laterally, the motion becomes a rotary one, and one or the other of the condyles becomes the center of motion, while the whole jaw rotates upon this center. The condyle at the center performs practically no motion except to rotate in its socket, while the opposite condyle moves considerably.

The point between the central incisors being the same distance from the center of motion as the moving condyle, the motion of the two points must be equal, as seen in Fig. 3. In this figure, the point of the triangle at C moves an equal distance with the point at B, while the triangle rotates about the point at A.

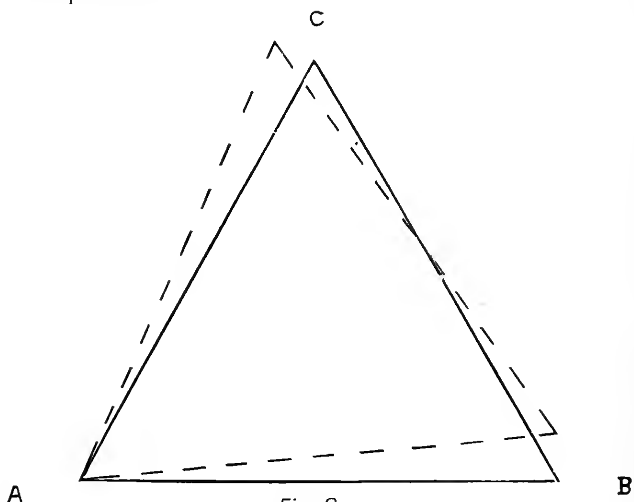

Fig. 3.

The same is shown applied to the lower jaw in Fig. 4, where it is seen that as the jaw moves a certain distance laterally in the region of the incisors, one of the condyles moves an equal distance forward, while the other condyle rotates in its socket. It might easily be supposed that one condyle moved backward while the other moves forward, but such is not the case. The ligaments of the tempero-maxillary articulation do not permit it. There can only be motion forward, and except the rotation of the condyle in its socket, there is no motion except upon one side at a time.

It is seen that this is simply reversed when the jaw moves laterally to the other side, so that there is the same condition of things no matter to which side the jaw moves.

It is also seen that when the jaw is thrown to one side, for instance, the right, that the molars and bicuspids of the right side are made to slide over each other linguo-buccally, while on the left side they slide over each other antero-posteriorly. The incisors of the right side slide across each other nearly labio-lingually, and occlude in such a manner as to perform considerable incising, while those of the left side perform none.

Mastication.

Considering the matter further, we see in Fig. 5, Fig. 6 and Fig. 7 that when the jaw is thrown to the right, the teeth are in contact upon that side from the central incisor back to the last molar, while upon the left side they are in contact at only one point upon a posterior tooth. It is thus seen that mastication takes place upon only one side at a time, or at least heavy crushing and grinding (which is performed best by the lateral move-

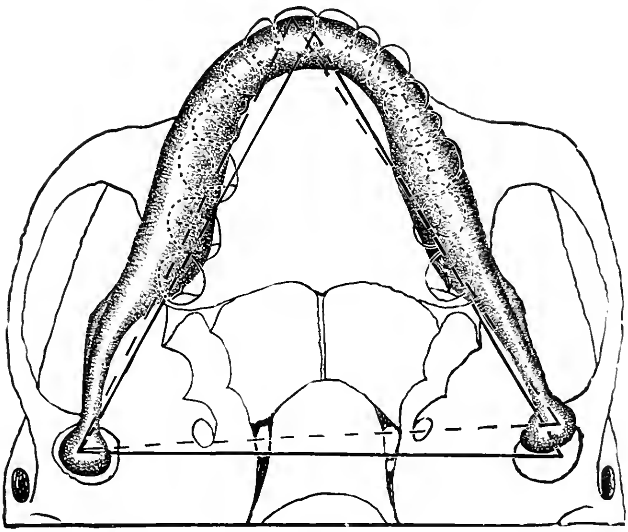

Fig. 4.

ment of the jaw) is possible only on one side at a time. Some crushing is possible upon both sides at a time by the simple hinge motion, but this is not used in work requiring much real cutting and grinding.

A further illustration of the crushing power of the lateral movement is shown in Fig. 8. It is there seen that there is grinding and cutting only when the jaw has been thrown to one side and returns to its original position; that it is upon the return stroke that the work is done and not upon the initial movement, as the tendency during this movement is to push food out from between the teeth rather than in between the cusps.

The buccal slope of the buccal cusps of the lower also shears against the internal slope of the buccal cusps of the upper, and this shearing or

cutting performs a great deal of work with comparatively little force, the same as a light pair of shears may cut a sheet of metal with but little effort, while it would require great force to cut the same metal in two

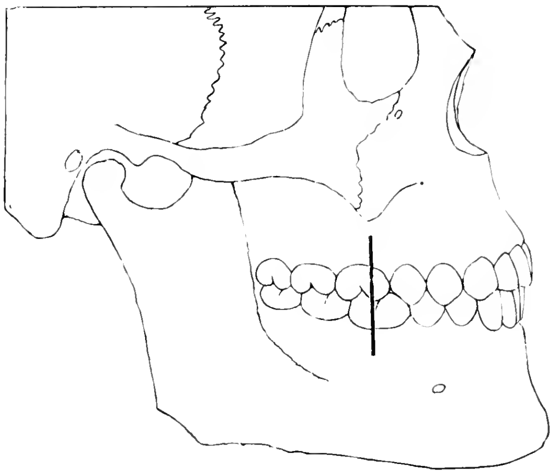

Fig. 5.

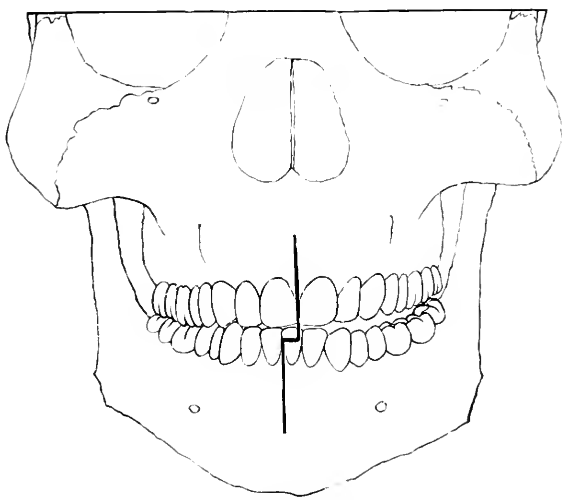

Fig. 6.

with a chisel. It is this shearing or cutting by cusps gliding over each other that performs most of the work of cutting up our food. If we were compelled to crush our food by straight crushing force alone, we would require jaws and masseter muscles like a hyena.

Fig. 8 does not correctly show the occlusion of the side opposite from where the work is done, but shows that some contact on that side is necessary and is normally present to keep the muscles of mastication from drawing the jaw unduly forward on that side. The muscles of mastication contract equally upon both sides even though work is performed on one side only, as may be seen by trying to bite hard on one side of the

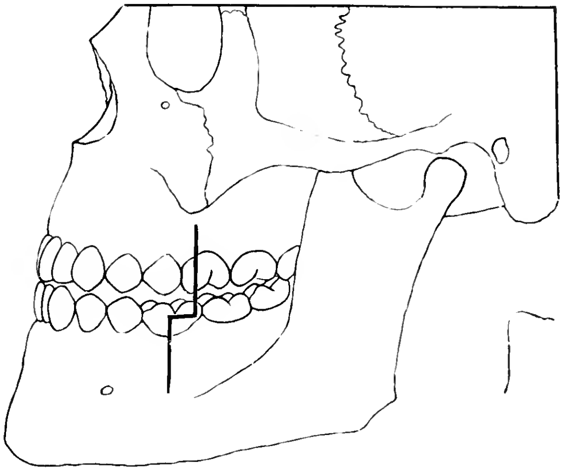

Fig. 7.

mouth without contracting the muscles of the other. By considerable practice one side may be contracted at a time, but ordinarily both sides contract alike, at least so far as the masseter and temporal are concerned.

Returning to Figs. 5, 6 and 7, we see that all the occlusal planes of all the teeth on the right side are being utilized during mastication on

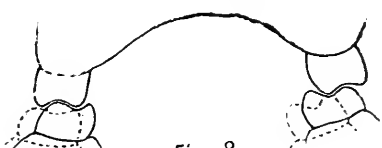

Fig. 8.

that side. Both buccal and lingual rows of cusps on the molars and bicuspids are interdigitating in the most perfect manner, and each tooth, whether upper or lower (excepting the upper third molar), is occluding with two opposing teeth. We thus see what a powerful factor each tooth is in determining the position of both its antagonists and its neighbors, and we see the combined influence of all the lower teeth of one side exerted upon all the upper teeth of that side, and vice versa. Each tooth is held in place by two others, and in its turn helps hold them in their places.

If one tends to move, it is resisted by both its antagonists and its neighbors, but if it does move out of place, it also disarranges more than itself. Men that go wrong usually work havoc upon many others also.

Influences of Occlusion on Form of Arch.

We see the influence of the teeth upon each other, and these combined influences create the form of the arch. If these influences are all in harmonious relation to each other, the result is a perfect articulation and a perfectly formed arch. If inharmonious in any way, the result is malocclusion to the extent of the inharmony.

We not only see the influence of the harmonious relations of the teeth in creating the arch, but what is equally important, in maintaining the arch in perfect form as well. This must not be overlooked nor underestimated. It is necessary to have a perfect occlusion all along the line to have a perfect maintenance of the arch. The molars—even the second and third—are just as important in their effects upon occlusion as the other teeth. Unless these teeth allow perfect antagonism of the other teeth during the movements of mastication, a slight malposition of one of them may allow or even promote the return of a malocclusion that has otherwise been corrected.

The lateral motion of the jaw must be reckoned upon, for it continually occurs and is a powerful factor in determining the position of the teeth. Heavy mastication usually occurs upon its use, during which much force is brought upon the teeth, when the tendency is to firmly lock the teeth in the proper place, if they are properly located, and equally as effective in tending to force them into another and improper position, if wrongly placed.

Because the lower jaw comprises a triangle, and on account of its motion as described, the teeth are forced into a certain form corresponding to its motion. If the jaw was of a shape other than an equilateral triangle, or if it moved in a different path from what it does, the dental arch would be of different form, else occlusion could not occur. The teeth are dragged into the present form of arch by virtue of their cusps and interdigitations, and their positions as well as their very shapes and sizes are a product of the mechanical forces operating upon them.

Knowing the shape of the jaw and its path of movement, we are able to determine the form of arch that is produced under favorable circumstances, as well as why it is produced. We are also able to see resemblances of and efforts towards this form of arch even in malocclusion, for Nature intends every arch to be perfect in form. If we can illustrate and analyze the perfect arch formed by a normal occlusion, we have a standard and a guide in our work; an end to strive to attain in our operations. We would have the assurance that if our cases of malocclusion were reduced

to this perfect form of arch, there would result a perfect occlusion in all particulars, which would maintain itself when the help of retaining appliances were finally removed.

It is possible to formulate rules for the formation of a dental arch in which there will be perfect occlusion when completed. The sceptical will no doubt say "important, if true" to this statement, but it is both true and important.

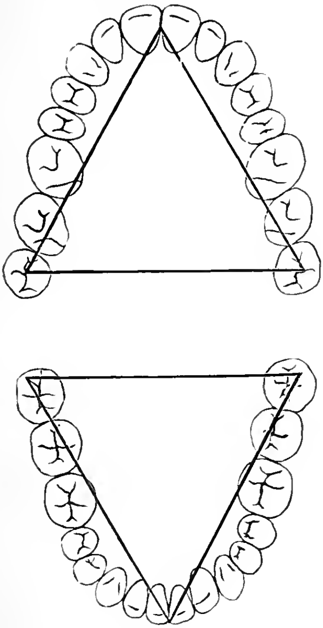

Fig. 9.

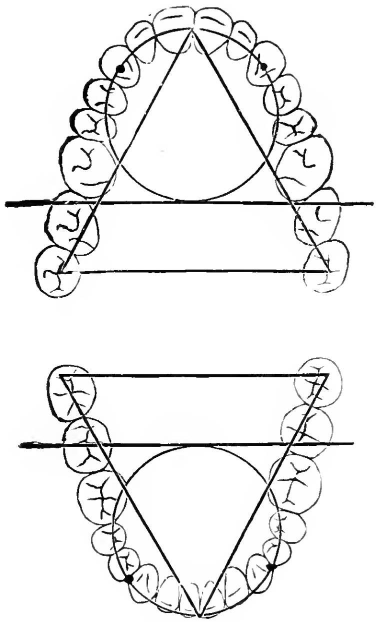

Fig. 10.

Geometry of the Arch.

If we return to Figs. 1 and 2, we see that the sides of the triangle pass through the third molars. If we connect the sides of the triangle together at this point, we create a smaller triangle, but one which is equal sided, as any such division of an equilateral triangle still leaves another equilateral triangle. This smaller triangle furnishes another base in our further study of the arch. In the upper, the points of the triangle are located in the central fossæ of the third molars, and at the point on the lingual surfaces of the centrals before noted. The disto-buccal cusps of the lower third molars normally occlude in the central fossæ of the uppers, and the points of the triangle of course should be located on these cusps for the lower jaw with the forward apex, as has been noted before. (Fig. 9.)

Next after the establishment of this triangle is the fact that the six anterior teeth are arranged around a segment of a circle. The size of this circle varies according to the size of the teeth, but always bears the same relation to the arch, whether the teeth be large or small. Bonwill gave a most elaborate way of determining the size of this circle, but a simpler and a quite accurate way is to draw (or imagine) a line connecting the mesio-buccal cusps of the upper second molars, and then produce a circle just large enough to extend from the forward apex of the triangle to this line. (Fig. 10.) The six anterior teeth should follow the curvature of this circle. In the lower arch, the line extending from molar to

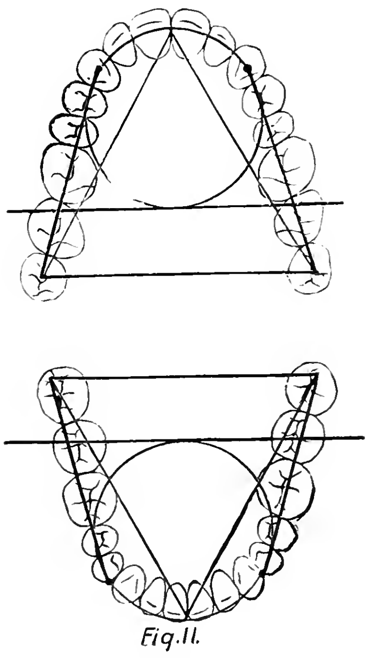

Fig. 11.

molar should be drawn where the cusps of the uppers occlude, which is in the buccal groove of the lower second molars.

In the upper the circle passes on the lingual side of the centrals, laterals and cuspids, and in the lower on the labial side of these same teeth. On the upper a point is noted on the cuspid about the center of the tooth and just within the cusp. On the lower a corresponding point is noted at the disto-labial margin of the cuspid, almost against the first bicuspid. From these points a straight line extends backward to the corners of the base of the triangle, and this line passes through the sulcus between the buccal and lingual cusps of the molars and bicuspids in case

of the upper, and along the summit of the buccal cusps of the molars and bicuspids in the lower. (Fig. 11.) It is commonly supposed that this line is more or less curved, but the examination of a number of models will disprove this. The line is straight, even in most cases of malocclusion, and the supposed curve is an illusion caused by the varying bucco-lingual diameter of the bicuspids and molars. The buccal surfaces of these teeth describe a curve, but the line through their sulci or along their buccal cusps is straight. The reason for this is that the greatest power results from this straight line, and the constant movement of the jaw in its appointed path has gradually forced the teeth into this very form.

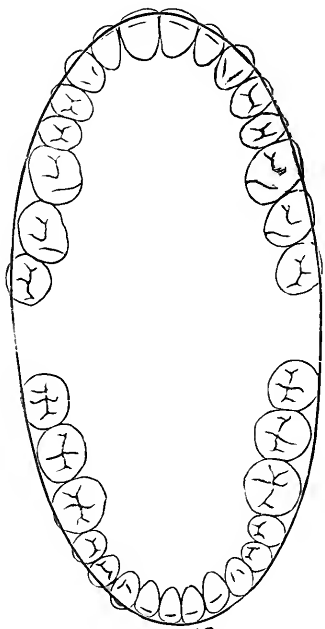

Fig. 12.

There now has been shown certain definite rules and lines concerning the dental arch, and teeth arranged along these lines will articulate perfectly if normal in size and shape. There is a tendency among some to scoff at the idea of arranging a dental arch along these or any other lines; the claims are made that they do not fit all cases; that temperament varies the arch; that some allowance must be made in individual cases; and even that the whole thing is impractical and utter nonsense.

The facts are that if Nature were not thwarted in her purposes, every dental arch would be upon these perfect lines. The mechanics of the case

compel an arch of this form to permit of the highest usefulness, and the mechanical forces of mastication produce this arch as nearly as possible. Even in malocclusion the teeth follow this perfect form just as much as the mechanics of the case admit. The mechanics of the case demand an arch of a certain definite form because of fixed and unchangeable laws, and not because somebody thinks it ought to be that way, or because it makes a pretty diagram on paper. As long as the jaw comprises an equilateral triangle and rotates upon one condyle at a time when moving laterally, just so long will this form of arch be the one unvarying end that Nature tries to attain in her way and be the one final result that we should seek in our work. Until the lower jaw changes its form or its motion, all men will (or should have) arches of the present form, and race, color, temperament, or hobby, fad or ism will not change the facts in the least.

The writer believes that the old description of the dental arch that it "describes a parabolic curve," or "is elliptical in form when the two arches are combined," is too indefinite for modern needs. Neither a "parabolic curve" nor an "elliptical form" are fixed figures like the circle, the equilateral triangle or the straight line. A watermelon is "elliptical" in outline, yet no one would regard, "shaped like a watermelon" as a very definite description.

It is true that measured from the buccal and lingual surfaces, the arch does describe an ellipse or parabolic curve (Fig. 12), but different teeth have different labio-lingual diameters, and while the "business end" of different sets—the buccal row of cusps in the lower and the sulci of the uppers into which these cusps fit—may conform to the lines laid down, yet the "curve" and the "ellipse" would be a varying quantity in each and every set.

In conclusion let it be said that only a few of the points concerning occlusion have been touched upon, and these notes must not be taken for anything more than their title indicates. Nothing has been said of the curvature of the dental arch according to the length of cusps and overbite, nor of the movement of the condyle within the glenoid cavity, nor of the anatomical characteristics of the tempero-maxillary articulation nor of many other things that would be needed to make a complete article. Indeed it would take a volume to present the subject of occlusion in its entirety. If these few points prove of benefit in establishing even part of the truth, the writer will be content, and in the future a more ambitious attempt may be made.

A Critical Review.

By Richard Summa, D.D.S.

Orthodontia is that department of dentistry which has but recently emerged from chaos, a science. An understanding of its fundamental principles has been placed within the grasp of every one interested in dentistry. Since the general practitioner is called upon to advise in all matters pertaining to the welfare of the organs of mastication, he must henceforth include one other branch when rendering an opinion. Formerly the dentist searched but for defects caused by decay; of late years the intelligent practitioner added to his responsibilities the prevention and alleviation of diseased conditions of the structures immediately surrounding the teeth, and now it has also become his duty to prevent and correct malocclusion of the organs of mastication.

While it may not be the desire of every dentist to undertake the correction of malocclusion, all should be sufficiently conversant with the fundamental principles of orthodontia to recognize the initial stages of malocclusion and consequently expend his efforts in operative and prosthetic dentistry in a manner best calculated to retain and restore normal occlusion. It is the general practitioner who has the earliest opportunity to warn the young patient of an approaching malocclusion which in the course of a few years would both impair mastication and destroy the harmony of facial lines. Being able to recognize such a condition early, his warning will be of inestimable value to his patient and he may have the great satisfaction of conquering one more of the hitherto supposed inevitable evils.

I know that many conscientious dentists have despaired of ever being able to correct malpositions of teeth; others have considered orthodontia a snare and a delusion after having attempted to correct malpositions of teeth according to methods void of fundamental principles. Orthodontia, not unlike other branches of dental science, has also suffered from the curse of too frequent publication of superficial and therefore misleading and misrepresenting articles. No doubt, the fact that most writers upon this subject have considered their orthodontia cases side issues, accounts for the glaring superficiality and carelessness displayed in these articles. Dentists had, and, I am sorry to say, many dentists still have but a vague idea of what really constitutes a malposed tooth. It is true, certain forms of malposition cannot evade detection by even the most careless eye and are therefore treated by some so-called simple method and corrected—

only by the engraver's pencil; while other malpositions are not recognized at all.

Every one at all familiar with the literature upon this subject has seen hundreds of illustrations of malposed teeth. Many of these presented only a part of one arch; about the same number of pictures presented one entire arch; while but a very small proportion showed occluded models. These illustrations offer conclusive proof that the writers recognized only the fact that a certain tooth or certain teeth occupied one or more of the seven possible malpositions. He did not know that the normal as well as the abnormal position of a tooth depends not only upon its relation to the adjoining teeth of the same arch, but also upon its relation to its antagonists of the other arch. He did not realize that abnormally as well as normally posed teeth were being retained in their respective positions not only by virtue of their approximal contact, but also by virtue of their occlusal contact. Had he been aware of this fundamental principle, he would have been aware of the absolute necessity of breaking up this abnormal contact and bringing about an improved occlusal contact when correcting malpositions.

"*Occlusion is the basis of the science of orthodontia.*"

In these few words Dr. E. H. Angle has revealed to us the secret which had so long obscured our aim in the correction of malposed teeth. The day of recognition and application of this fundamental principle marks the beginning of modern and true orthodontia.

This basis having been established, what could have been more logical than a classification of maloccluding teeth based upon their relation to normally occluding teeth? This grand diagnostic means is given us in the "*three classes of malocclusion.*"

Fixed Versus Removable Appliances.

Second in importance to the recognition of occlusion as the basis of the science of orthodontia has been the decided preference shown by modern orthodontists for the employment of "*fixed appliances*" to the entire exclusion of the "*removable form of appliances.*" It might seem a waste of time to call attention to this advance, were it not a fact that recently a writer upon this subject informed the readers of his journal that in many instances the much derided plate, even when made of vulcanite, is vastly superior as well as more quickly constructed than the fixed skeleton form of appliance.

When reading about the vast superiority of removable appliances over the fixed skeleton appliances, we are caused to wonder what revelation the author of such claim has in store for the patient reader.

For sake of emphasis I repeat my claim that plates, when used as regulating appliances, are detachable, ever-loosening, bulky, foul-smell-

ing and crude. The modern gracefully proportioned, beautifully finished and efficient skeleton form of appliance can be more rapidly adjusted and at the same time more accurately adapted to the requirements of any case. Only the fixed skeleton appliance permits of the employment of the various indispensable kinds of anchorage and the exercise of the absolutely necessary even and uninterrupted pressure.

In the face of these indisputable facts we must wonder what motive there can be to induce any one to uphold, yea, resurrect removable appliances, especially in the form of rubber plates.

Again, the combined result of our recognition of occlusion as the basis of the science of orthodontia, the Angle classification of malocclusion and the employment of fixed skeleton form of appliances has permitted us to accomplish the restoration of the normal contour of the face.

Dr. Goddard's Work Criticised.

The correctness of these teachings of modern orthodontia having shown itself capable of proof by abundant clinical experience, it is surprising to note that some recent publications betray the fact that all writers have not been able to keep pace with the rapid advance of modern orthodontia. It is especially to be deplored when writers of text-books fail, for any reason whatsoever, to present to the student anything but the latest accepted teachings. I deem it not only the privilege but the duty of every one interested in the welfare of a science to criticise faulty and obsolete teachings in order to hasten their early elimination.

In accordance with this conviction I herewith present a critical review of the chapter on orthodontia in the latest edition of "The American Text-book of Operative Dentistry." Considering this chapter as a whole, the reader is impressed by the fact that it belongs to that unfortunate class of compilations of methods of others in which "the salient features for insuring success are not mentioned." One, familiar with such compilations, will readily recognize the vast majority of appliances suggested in Dr. Goddard's chapter as *old* acquaintances. Most of these appliances have accomplished anything but the result expected of them. Their employment cannot but harm any and every one concerned in their application and their resurrection in a modern text-book, for any purpose except as a matter of history, must be considered a great injustice to orthodontia at its present advanced stage.

Dr. Goddard begins this chapter by devoting a few short paragraphs (29 lines) to the normal arch, the ideal facial profile and normal occlusion. These important subjects are treated so superficially and consequently minimizes their value to such an extent that one not previously

acquainted with their importance is caused to wonder why they are mentioned at all.

On page 685 of "The American Text-Book of Operative Dentistry" Dr. Goddard writes: "Malocclusion may be of many kinds and degrees, to which no general description can be given. The nature of such malocclusion of the arches as a whole may be indicated by the position of the second lower bicuspid, which is the key to the occlusion; according to its position the occlusion of the arches may be described as normal, distal, mesial, lingual or buccal.

If the key tooth, the second lower bicuspid, closes between the upper bicuspids, with its buccal cusp between their buccal and lingual cusps, the occlusion of both the key tooth and all the others is normal."

Dr. E. H. Angle's classification of malocclusion was published in the *Dental Cosmos* of March and April, 1899; Dr. C. L. Goddard's chapter on orthodontia was published in the fall of 1900. Therefore, the statement that no general description can be given to malocclusion must be construed either as a serious and inexcusable oversight or as a declaration on the part of the author of the incorrectness of the classification as taught by Dr. Angle and proven by clinical experience to all who have investigated this subject.

If the key tooth, the second lower bicuspid, occludes normally, Dr. Goddard would have us infer that all other teeth occlude normally. According to this statement the doctor ignores all malocclusions found anterior to the cuspids, *the great first class.*

On page 712 we find the following: "For convenience in description, irregularities are here arranged in fifteen classes. The first six have reference to single teeth, and nearly all the rest to the arches as a whole in relation to each other and to the contour and profile of the face.

(In order to compare the Goddard arrangement of irregularities with the Angle classification of malocclusion, I herewith present them side by side.)

Dr. Goddard's Arrangement.

1. Lingual eruption: A tooth erupted lingually.
2. Labial eruption: A tooth erupted labially.
3. A tooth rotated.
4. A tooth extruded.
5. A tooth partially erupted.
6. Several teeth in any or all positions.
7. Prominent canines and depressed laterals.
8. Pointed arch. (V-shaped.)
9. Upper protrusion.

10. Lower protrusion.
11. Double protrusion.
12. Constricted arch. (Saddle-shaped.)
13. Lack of anterior occlusion.
14. Excessive overbite.
15. Separation in the median line.

Oh, what a return to chaos! No sooner have we been taught a distinction in nomenclature and significance between malposition of teeth and malocclusion of the dental arches when we are again confronted by this confusion.

The seven malocclusal positions as taught by Dr. Angle are:

1. Mesial.
2. Distal.
3. Lingual.
4. Buccal.
5. Infra.
6. Supra.
7. Torsal.

A tooth may also occupy any possible combination of these malocclusal positions.

Any tooth occupying any of the above-mentioned malpositions must be in malocclusion with its antagonists and consequently bring into malocclusion all teeth of both arches depending upon it for position; hence the classification of malocclusion as taught by Dr. Angle:

Class 1.—Arches in normal mesio-distal relations.

Class 2.—Lower arch distal to normal in its relation to the upper arch.

Division 1.—Bilaterally distal, protruding upper incisors. Usually mouth breathers.

Subdivision.—Unilaterally distal, protruding upper incisors. Usually mouth breathers.

Division 2.—Bilaterally distal, retruding upper incisors. Normal breathers.

Subdivision.—Unilaterally distal, retruding upper incisors. Normal breathers.

Class 3.—Lower arch mesial to normal in its relation to upper arch.

Division.—Bilaterally mesial.

Subdivision.—Unilaterally mesial.

The word "eruption" used in the description of numbers 1 and 2 of Dr. Goddard's arrangement is applicable only to a part of the class the author desires to describe, for it does not apply to that large number of teeth forced into lingual or labial position after having fully erupted.

Numbers 3, 4, 5 and 6 convey the desired meaning.

No. 7 implies lingual or labial positions, hence should be classed with numbers 1 and 2.

No stronger evidence can be adduced for the great need of a distinctive nomenclature for orthodontia than the words employed by Dr. Goddard in the naming of classes 8 to 15. After describing on pages 685 and 686 *his* classification of malocclusion based upon the position of the second lower bicuspid, his lack of adherence to this classification displayed at this crisis must be construed as a failure to comprehend the importance of occlusion. Why should he not adhere to the terms "distal and mesial occlusion" in preference to "upper and lower protrusion?" The term

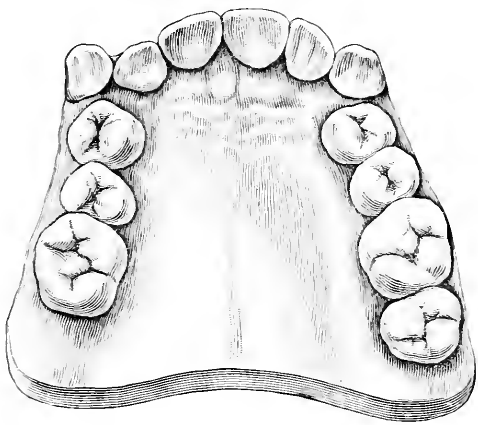

Fig. 1. (Goddard's 723.)

"V-shaped arch" and the names of all the other classes tell us nothing definite, while the mention of a class of malocclusion (according to Angle) conveys positively the location of an abnormal relation of the arches and consequently suggests clearly and distinctly a principle of procedure for establishing harmony. This lack of fundamental principle is characteristic of every method described in this chapter. Dr. Goddard did not even mention occlusion in connection with the name of the man who, by publishing his recognition of occlusion and malocclusion, founded modern orthodontia. For reasons, known only to himself, the author has contented himself by referring only to methods (many of these having been discarded) employed by Dr. Angle during the evolution of his present teachings, an injustice, not only to one man, but to all men interested in the speedy promulgation of scientific truth.

In his description of *"Class 15. Separation in the Median Line,"* Dr. Goddard, by his silence in regard to Dr. Angle's article in the Nov., 1899, *Dental Cosmos* keeps the students of his chapter in ignorance of the cause and only remedy for this abnormal condition.

The acknowledged interdependence, for position, of the teeth of both arches dispels all possible doubt as to the existence of compensating malpositions of teeth in corresponding arches. Again, the author has seen fit to ignore this indisputable fact. Examples of this oversight in the chapter under discussion are too numerous to permit repetition. I shall, therefore, offer as evidence of my assertion only one fair sample. Fig. 1 (which in Dr. Goddard's chapter appears as Fig. 723) speaks for itself. Can any one conceive of such a malposition in the upper arch without a corresponding abnormality in the lower arch? Some tooth, usually a bicuspid, must be in lingual or labial occlusion because the anterior teeth

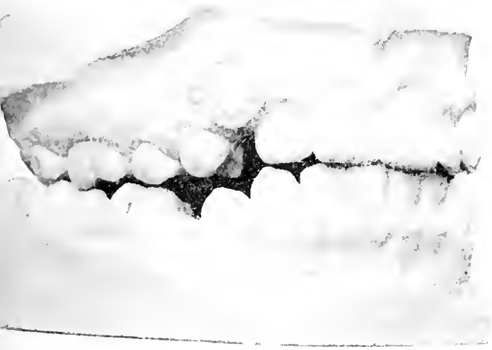

Fig. 2.—Right Occlusion.

Fig 2.—Left Occlusion.

of the lower arch have been moved distally by the malposed anterior teeth of the upper arch. Since, however, the author failed to recognize the malposition of the superior incisors and bicuspids, he cannot be censured for overlooking a malposition in the lower arch.

Fig. 2 shows a like case treated according to the precepts of modern orthodontia. In this case the superior incisors and first right bicuspid were moved to occupy their proper position in the occlusal line. This produced the exact space allotted by nature to the right superior cuspid. The right lateral, cuspid and first bicuspid of the lower arch were moved into their ideal positions, thus bringing about the space allotted the second bicuspid of the same side. In other words, this case belongs to "class 1" (Angle). The teeth of each arch were moved into their correct relation

Fig. 2.—Upper.

Fig. 2.—Lower.

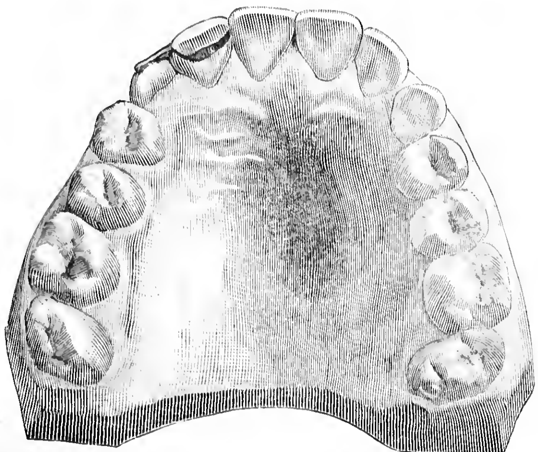

Fig. 2.—Upper. (Study Model.)

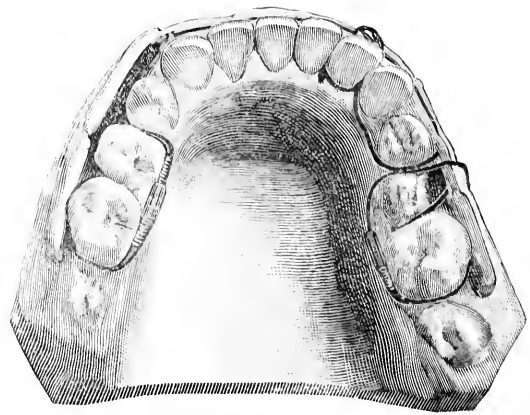

Fig. 2.—Lower. (Study Model.)

with its line of occlusion. This being accomplished, there was then perfect harmony of the two dental arches and perfect occlusion.

In treating a case as Fig. 2 was treated, we not alone insure permanent retention, but we also restore the normal facial lines, because we restore harmony in the sizes of the arches.

After considering Dr. Goddard's treatment of the labially occluding cuspid in conjunction with the statement (found on page 700) that "when the occlusion is already normal and the irregularity is slight, but cannot be reduced without seriously deranging one or both sides of the mouth, it may be best to permit the irregularity to remain as the lesser of two evils," we become convinced that the author has but a vague idea

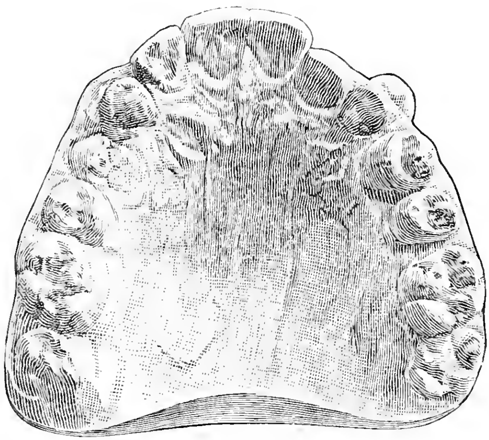

Fig. 3. (Goddard's 608.)

of occlusion, for there can be no "irregularity" without a malocclusion nor a normal occlusion with an "irregularity."

Value of Perfect Models.

Nothing will lend greater aid to the study of occlusion and malocclusion than will accurate models obtainable only from the most carefully taken plaster of paris impression. These *accurate models* being of such indispensable diagnostic value, we read with amazement on pages 710 and 711:

"Modeling compound is best adapted for impressions of most cases. Special cases may need the more absolute accuracy of plaster of paris, but such cases are rare."

Why this fear and dread of accurate workmanship? There can be no logical reason for the discouragement of accuracy. We are all fa-

miliar with the cry that time is too valuable for the "busy practitioner" to employ it to obtain accurate models. I answer this by stating that "anything that is worth doing at all is worth doing well," and being so done a commensurate compensation will be forthcoming. Aside from the failure of models made from modeling compound impressions to fulfill the

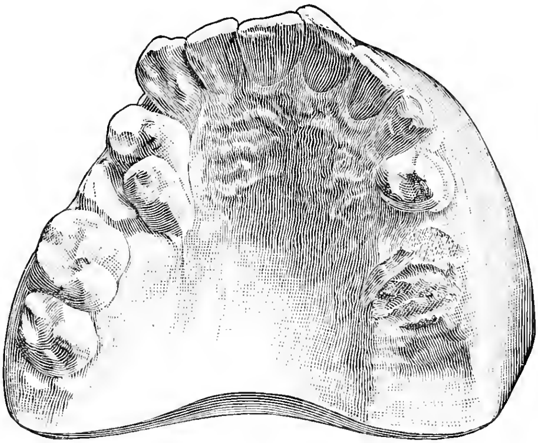

Fig. 4. (Goddard's 609.)

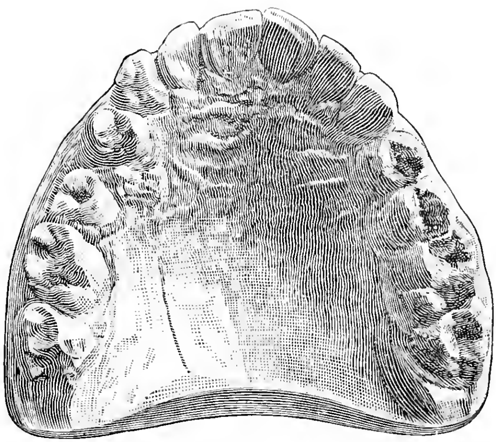

Fig. 5. (Goddard's 610.)

purpose for which they are intended they encourage carelessness and slovenliness, two attributes which are in need of no encouragement.

Figures 608, 609 and 610 (Figs. 3, 4 and 5) are fair samples of the result of modeling compound impressions. After deducting the improvements made by the engraver's pencil, the result will be a model unfit to

expose to the critical eye of a camera. Such models bear teeth distorted to such an extent as to render a study of occlusion impossible.

The necessity of obtaining perfect models for any and all purposes cannot be emphasized sufficiently. Not only does orthodontia require perfect models, but prosthodontia is equally justified in demanding accurate models. If like care and skill were expended in obtaining models of anomalies, half-tones could be used in illustrating, "for nothing is better than a half-tone from a perfect model, and nothing worse than the result of the same process from imperfect models."

Lastly I desire to take issue against the suggestion and publication of appliances which never have and never will accomplish the work for which they were designed. This chapter abounds in such pictures. The

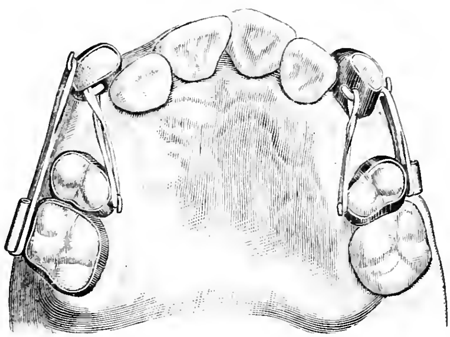

Fig. 6. (Goddard's 725.)

vast majority of these appliances are fanciful pen sketches of impractical devices. Time and space forbid a rehearsal of all appliances of this kind illustrated in Dr. Goddard's chapter. I shall therefore present for your consideration but a few selected at random.

Fig. 664 shows an appliance whose object is to move distally the bicuspids and the incisors toward the left.

As a retainer this appliance has no superior, but as an appliance for moving teeth it is a most decided failure.

Fig. 725 shows an attempt to move a cuspid distally by means of rubber bands, using the second bicuspid for anchorage, while the first bicuspid has been extracted to create room for the cuspid (Fig. 6). First of all, instead of the cuspid moving into the desired position, the bicuspid will be moved mesially. The author, as yet, not having become impressed with the necessity of obtaining, studying and exhibiting occluded models renders his recommendation of removing the first bicuspids questionable

and at the same time keeps the student of this chapter in ignorance of his reasons for extracting. However, I venture to say that extraction in this case was contra-indicated. Furthermore, such an abnormal position of the teeth of the upper arch without a compensating malposition of the teeth of the lower arch does not exist, and unless the malpositions of the teeth of both arches be corrected, thereby establishing harmony in the sizes of the arches, failure must be the result.

Fig. 759 shows an appliance intended to retract the six anterior teeth after the first bicuspids have been extracted (Fig. 7). The anchor bands are placed on the first molars, the "labial bow" is applied and we are told, by turning the nut placed at the distal end of the tube on the anchor band

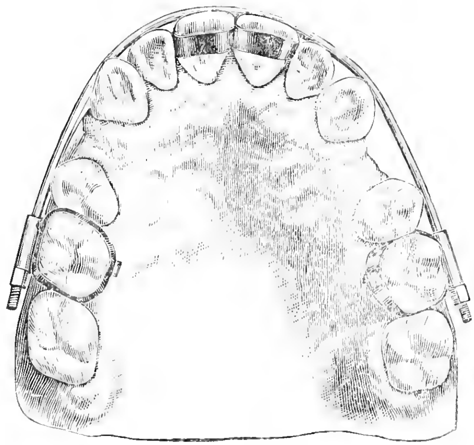

Fig. 7. (Goddard's 759.)

the six anterior teeth are drawn back till the cuspids occupy the vacant spaces. Even if the second bicuspid, and the first and second molars were used for anchorage, the desired movement could not be accomplished, consequently an anchorage of only one tooth on each side must bring about a more disastrous result. Aided by the inherent tendency of all teeth to move forward, this appliance will cause the spaces to be filled by moving the second bicuspid and the molars forward, thus producing a more serious abnormality than the original.

These are fair samples of the methods and appliances suggested in Dr. Goddard's chapter. In concluding my criticism of this subject I desire to express the sincere hope that the time has arrived when "compilers of methods of others" will prove their sincere interest in those seeking their compilations as sources of knowledge by eliminating from books such methods as "Immediate Regulating" promulgated by Dr. C. L. Bryan and Dr. Geo. Cunningham.

A retrospect of this criticism brings to mind the defective nomenclature heretofore so freely indulged by writers. Perhaps the most misleading of all is the term "irregularity of teeth." This term merely implies an abnormity, which may manifest itself in the form, size, color, structure, number or position and occlusion of teeth. The terms malposition, malocclusal position and malocclusion have reference to distinct and definite abnormities. Another decided improvement is found in the naming of the seven malocclusal positions. Had the author of the chapter under consideration been more familiar with nomenclature of modern orthodontia, he would have refrained from stating that no general description can be given to malocclusion, while on another page he arranged, for sake of convenience, irregularities into fifteen classes; nor would he write that "when the occlusion is already normal and the irregularity is slight, etc."

"I think most of the gentlemen feel as I do about this regulating business. It gives them a cold chill to have anything to do with it." This was the characteristic utterance of a dentist during the discussion of a paper on orthodontia read before a state society. A cold chill—with fatal result—no doubt is the only logical consequence of imbibing knowledge from writings such as I have reviewed. However, *modern orthodontia* bears a message of incontestable facts and hopeful encouragement to all weary and dejected.

The Ground-Work of Orthodontia Essential to the General Practitioner.

By Wm. Ernest Walker, D.D.S., M.D., Pass Christian, Miss.

Lest from the title of my paper it might be inferred that an argument against specialism is intended, and someone be misled, I will say at once that such is not my purpose. On the contrary, there is too abundant evidence that the marvelous progress made in the various departments of medicine, including that branch pertaining to the mouth, has been due to no cause more absolutely than to specialization, but even then the greatest and most positive progress has followed specialization, only when preceded by the most thorough preparation in the ground-work; in other words, thorough early training in the fundamental principles on which all superstructure, in the form of higher education and specialization must depend for its only secure foundation.

While this preliminary building of the foundation is an important part in the make-up of the level-headed specialist—one who takes all

things into consideration instead of giving his thoughts merely to the accomplishment of the single present object, without due consideration of the entire constitution and life of the individual, it is of equal importance that the general practitioner should be familiar with the groundwork of *all* specialities. Nothing short of this will enable him to deal the most successfully with the greatest of all his functions, *prophylaxis.*

This is true of all the specialties of medicine on the one hand, and to general medicine and surgery on the other, as well as to the larger specialties which may with profit be further subdivided into more definite specialties; and here we class the general practice of dentistry which seems suitable for subdivision into more defined specialties—notably orthodontia. It cannot be denied but that there is much in orthodontia which adapts it to be practiced as a specialty, and one worthy of the entire attention of one free from the cares and duties of general practice.

Not that the general practitioner should know less of orthodontia, but that the specialist should know more of orthodontia and facial orthopedia. The general practitioner in dentistry should not only *not* know less of orthodontia than at present, but he should know *more* of the *ground-work;* have a better understanding of the underlying principles of prophylaxis; of the physiology of tooth-movement and retention; a more thorough knowledge of anatomy, macroscopic and microscopic, and better appreciation of facial form and expression, and last, but not least, be better able to diagnose abnormalities and their character.

Classification.

To this end *classification* plays an important part. Classification has received entirely too little attention at the hands both of the general practitioner and the orthodontist, if we may judge from the literature upon the subject. I am fully persuaded that many blunders might be avoided if we had always in mind a good working classification, enabling us to correctly classify each case before undertaking correction.

I have not found in our literature any classification that is *entirely* satisfactory to me, and therefore venture on this occasion to offer an amplification of "Angle's classification."

Although a little more elaborate, to my mind it is sufficiently more comprehensive and practically useful to abundantly compensate for its cumbrous character. That I may not be accused of taking credit for that which is not original, I will first reproduce Angle's classification and then my modification (or amplification) of it.

Class I.—Arches in normal mesio-distal relations.

Class II.—Lower arch distal to normal in its relation to upper arch.

Division 1.—Bilaterally distal, protruding upper incisors, usually mouth breathers.

Subdivision.—Unilaterally distal, protruding upper incisors, usually mouth breathers.

Division 2.—Bilaterally distal, retruding upper incisors. Normal breathers.

Subdivision.—Unilaterally distal, retruding upper incisors. Normal breathers.

Class III.—Lower arch mesial to normal in its relation to upper arch.

Division.—Bilaterally mesial.

Subdivision.—Unilaterally mesial.

Dr. Angle's classification is well worthy of our acceptance as a *foundation*, but as a finality, it is to me deficient, in that it fails to provide for a distinction between cases in which the upper teeth are mesial of their proper position, and cases in which the lower teeth are distal of their proper position.

These cases are all brought under Dr. Angle's Class II, where we find them in two divisions according as to whether the upper incisors protrude or retrude, each division having a subdivision according as to whether the malocclusion is unilateral or bilateral. Class II. is described as including all cases in which the "Lower arch is distal to normal in its relation to the upper arch."

It is to my mind apparent that there should be a distinction between those cases in which the defect is really in the lower arch, as distinguished from those in which the defect exists in the upper arch. For instance, we may have two cases, both arranged in Class II, because the lower arch bears a distal relation to the upper, yet they may still be very different from one another, for in one case, the upper arch may be in its normal position in relation to the rest of the face, still the lower arch be distal in relation to the physiognomy as well as in relation to the upper arch; while in the other case, although the relation of the lower to the upper is the same, it in reality requires a different heading because here the lower arch bears a normal relation to the rest of the cranium and face, the defect really being in the upper arch, which is mesial not only in its relation to the lower arch, but also in its relation to the physiognomy. To treat the two cases alike would be a very grievous error.

The first is a sub-inferior labial case, and the lower arch needs to be advanced (by jumping the bite probably unless that would give too much chin). The other case is pro-superior labial, and it would be a fatal mistake to harmonize the arch by advancing the lower, the remedy being to retract the superior arch. This should be classed as superior-mesial-occlusion; the other as inferior-distal-occlusion. There would, of course, be a further subdivision in each case, if only unilateral. The same distinction would be made in Class III, where the lower arch is mesial to normal

in its relation to the upper arch, it may nevertheless from the facial point of view be in normal position, the defect being in the upper arch, which in this case would bear a distal relation not only to the lower arch, but to the face itself.

Upon this basis we would have the following

Classification of Maxillary Orthopedics.*

Class I.—Arches in mesio-distal relation, normal; *anterior* teeth malposed.

Class II.—Lower arch distal to normal in its relation to upper arch.

Subclass I.—Lower arch retruded in its relation to the physiognomy.

Division I.—Bilaterally distal, protruding upper incisors; usually mouth breathers.

Subdivision.—Unilaterally distal, protruding upper incisors; usually mouth breathers.

Division II.—Bilaterally distal, retruding upper incisors; normal breathers.

Subdivision.—Unilaterally distal, retruding upper incisors; normal breathers.

Subclass II.—Upper arch protruded in its relation to the physiognomy.

(Divisions and subdivisions same as in subclass I of Class II.)

Class III.—Lower arch mesial to normal in its relation to upper arch.

Subclass I.—Lower arch protruded in its relation to the physiognomy.

Division.—Bilaterally mesial.

Subdivision.—Unilaterally mesial.

Subclass II.—Upper arch retruded in its relation to the physiognomy.

(Division and subdivision same as in Subclass I of Class III.)

The Power of Specialization.

By L. W. Beardsley, M.D., St. Louis, Mo.

It is impossible in a paper of this kind to give aught but a rather cursory review of the subject, inasmuch as it is to be considered in a general manner, and must of necessity, therefore, because of that very generality, lack that thoroughness which might otherwise obtain. Furthermore, it will be possible only to go into rather an abbreviated and strictly abstract discussion of our subject, for I am sure, if you will ponder for but

*This proposed classification was not adopted by the Society.

a moment, you will realize the impossibility of a concrete consideration, without compiling a complete chronology of all discoveries and inventions, barring those of accidental origin, which the world has seen; for have they not been the results of specialized effort, or of especial talent or fitness, in the line of the accomplishments?

Specialization is not of recent origin, despite the contentions of those who maintain the contrary, but has existed since the world was in its swaddling clothes. What is the tiller of the soil but a specialist, or what the huntsman? What the carpenter, the shoemaker, the tailor, the mason, the butcher, the baker, or candle stick maker? Are not their energies directed, either because of inherent ability or as the result of education, along constricted or special lines? If a carpenter demonstrates by his work that he is more than an ordinary craftsman, and is assigned to the task of putting the finer finishing touches to a piece of carpentry, may we deny that here is a specialty within a specialty? For fear of a misunderstanding of my argument, and in order to present to you in possibly a clearer manner the thoughts that I wish to convey, let us see what the dictionaries contain upon the subject.

Power.

In studying the lexicography of "power," one finds varied and sundry applications of the term. For instance, "power" is used to denote "the ability to act, regarded as latent or inherent," or the "faculty of doing or performing something," or "the capability of producing an effect, whether physical or moral." Another group of definitions contains: "ability, regarded as put forth or exerted," and "strength, force or energy in action —for example, the power of steam in moving an engine, or the power of truth or argument, in producing conviction." A third group says it is the "capacity of undergoing or suffering," and the "fitness to be acted upon." And, too, we have "power" defined as "the employment of strength, the exercise of a faculty, any agency, moving force of anything, energy, rule, authority," and many others besides. In Webster's International Dictionary, Sir William Hamilton is quoted as saying, "Power then, is active and passive; faculty is active power, or capacity; capacity is passive power." When we come down to the specialized meanings of "power," we find, mathematically speaking, that it is "the product arising from the multiplication of a number into itself; as, a square is the second power, a cube the third power of a number." From a metaphysical standpoint we are admonished that "power is the mental or moral ability to act, or think, or reason, or judge, or fear, or hope, or will." In optics it applies to "the degree of magnification possessed by a lens, mirror, or any optical instrument, and usually denotes the number of times it multiplies, or augments, the apparent diameter of an object."

There are other specialized definitions of the word "power," but they are more or less irrelevant to the thoughts I wish to impress, so for the sake of brevity, I shall not repeat them, but proceed to what is commonly understood as specialization.

Specialization.

We find that the term is a derivate from *species,* which, logically, means "a group of individuals agreeing in common attributes, and designated by a common name; a conception subordinated to another conception, called a genus or generic conception, from which it differs in containing or comprehending more attributes and extending to fewer individuals." Thus man is a species, under animal as a genus; and man, in its turn, may be regarded as a genus, with respect to European, American, or the like, as species." We find, too, that special is defined as "limited in range; confined to a definite field of action, investigation or discussion; as, a special branch of study." Naturally, then, specialism or specialization, is the devotion of energy to a particular and restricted part or branch of art, knowledge or science.

You will wonder, perhaps, why I have gone such lengths into the lexicography of the terms used in the title of this paper, but it has been for a reason, and it is this: I wish to impress quite definitely the difference in meaning of specialization and generalization. To generalize is to "infer from one or a few, the nature of a whole class," or let us say rather, a generalization is a deduction made, or a conclusion drawn, from the survey of a group or genus as a whole, and perhaps you will allow a repetition of the illustration previously used, "that man is a species, under animal as a *genus*; and man, in its turn, may be regarded as a genus, with respect to European, American, etc., as species.

If we consider critically the definitional antithesis of the words generalization and specialization and give to both a common attribute, power, we must of necessity use the term as a measure or rather an index of relative value. And if we say that this relative term denotes the ability, or better, the capability for the achievement of results, or the attainment of an end, we can, inversely, say that the result achieved is an index or measure of the amount of power. Therefore, that both generalization and specialization possess power, is proven by the demonstrable results of its application. That these results vary in kind and scope is an equally provable fact, else further argument would be rendered impossible, and it is with this variation of results that we have to do. As stated before, we shall consider power as an attribute of generalization and specialization, in a relative sense, and endeavor to show the reason of an increase or decrease of potency in the one case or the other.

Force. In comparing the relative value of any two things, it is a much easier task if there be a fixed and definite entity which we can use as a standard. But in the consideration of so abstract a matter as the one in hand, we are handicapped because of the lack of such a standard, and the time and space for a voyage upon the limitless sea of concrete facts is unavailable. Such being the case, we must depend for our argument upon the analogous application of well-grounded, fundamental principles of general science, presupposing, on your part, a knowledge of concrete results when used in a particular direction. By way of preliminary explanation, the terms force and power will be used in a more or less synonymous manner. In Physics we are taught that "two masses are said to be equal when the same force, acting upon them separately, will produce in them equal accelerations." Again, "the rate of acceleration by the same force is less as the mass moved is greater." Forces are said to be equal when they can produce equal accelerations upon the same or equal bodies, and by comparison we are furnished a simple and accurate method of measuring forces, by balancing the forces to be measured against the weight of known masses. To produce in a given mass a given acceleration, the force must be proportional to the product of the mass into the acceleration.

Newton's second law of motion, "change of motion is proportional to the impressed force, and takes place in the direction of the straight line in which the force acts," let us remember especially, for it is the universal and unalterable experience in regard to the direction and amount of effect of forces. If we presume a definite force or power acting upon a definite mass, the rate of acceleration resultant therefrom will be definitely proportional. If, now, we divide the mass, but still employ the same equivalent of power, we necessarily increase the rate of acceleration. Another subdivision, and a proportionate increase in the rate of acceleration, and, of course, the further we subdivide the mass, still employing, however, the same quantity of power, the greater will be the rate of acceleration. Now, however, to what conclusion can we come when, instead of a known unit of power, we have an indefinite quantity to measure; how shall we proceed? Naturally enough by the determination of its action upon a given mass, with regard to the acceleration. We know that by balancing forces against the weight of known masses, we can measure those forces by the rate of acceleration, which will be greater or lesser in degree proportionate to the size or weight of the mass acted upon.

Psychical Application of Physical Laws.

It is remarkably true that we can apply general physical laws in manifold directions; a slight change as to nomenclature fits them for anyone's use, and the clearness of their logic makes them almost self-explanatory. In the present instance, let us substitute knowledge for mass, study for power, and attainment for acceleration. Surely then, attainment is resultant from the application of study to knowledge, and the rate of attainment will depend both upon the amount of study, and the bulk or mass of knowledge. Just as the mass of knowledge grows larger, so must our thoroughness decrease, if we direct our studies in a general way. But divide the mass of knowledge into gross divisions, and then divide and re-divide these, and, directing our power of study toward one of these subdivisions, does it not inevitably follow that our rate of acceleration, or our thoroughness of achievement, must proportionately increase? Because it is true, and because in "the struggle for existence" there is only "the survival of the fittest," have we been forced nowadays more than ever before, to devote our energies along constricted lines, for in doing so we acknowledge and take advantage of, the power of specialization.

Time was, perhaps, when an individual intellect could obtain mastery over, what then was, the known, but surely it was in the long-ago. I do not believe that the race is degenerating, either. The standard of mentality is higher today than ever before, and with our ever-increasing facilities for obtaining and imparting knowledge, despite what the pessimists say, I fail to see anything but progress for the future. Education! there's the keynote! Education in its broadest sense, as a means of fitting us to do the greatest good to our fellow-man. Not the old method of learning by rote, but the new, that appeals not so much to memory, but to reason. Not the telling to us the answer, but teaching to us the natural method of experimental investigation, whereby we can arrive at a conclusion by reason of our knowing the *how* and the *why*.

Fitch, in his "Lectures on Teaching," remarks that "a school is a very unsatisfactory institution, and fails to fulfill its highest function, if, however it may succeed in imparting knowledge, it does not also succeed in imparting a thirst for more." Sir Michael Foster, in a recent article on "The Scientific Use of Hospitals," maintains that "every touch of the surgeon, every counsel of the physician, is more or less of an experiment, for neither the one nor the other can be absolutely sure of the result of his act; while on the other hand, he is prepared to make use of the knowledge afforded by the result. . . . Were such experiments conducted, not for the welfare of the patient, but simply for the advancement of knowledge, there would be justification for the attitude just mentioned."

This, it seems to me, would be an ultra-radical utterance, were it not tempered by the justification of the means by the end; that is to say, whilst one may suffer, the multitude shall benefit thereby. That the world recognizes the value of experimental investigation along all lines of scientific thought, is evidenced by the immense increase in laboratory facilities in the progressive educational institutions and in private. The laboratory of today is not the same as the one of yesterday, for we have been accustomed to think of it as being fitted out for demonstrational purposes chiefly. Now, however, it serves a broader field, in that the equipment also comprises the necessaries for investigation, as well as for teaching. To again quote from Foster's article, "The duties of the head of every scientific laboratory and of his chief assistants should be three-fold; first: To teach beginners what is known; second: To carry on personal research into the unknown; and, to train those who are no longer beginners the way of inquiring after the truth." And are we not all seekers after the truth? No man can know all of science, and all men can know some of science, and, as Fitch says, "That study is best for each of us which calls out the largest amount of spontaneous exertion, and in which we are not recipients merely, however diligent, but willing agents." Knowing as we do, what a great, unbound volume science is, and realizing fully, I hope, that "what is worth doing, is worth doing well," is worthy of our supreme effort, and believing with a firm and steadfast belief that thoroughness is only achieved through concentration of purpose upon a constricted field of application, perhaps you will join hands with those brethren of all times and ages who, realizing the infinity of knowledge and the very finite nature of man's capability for effort, did not attempt to learn something of everything, but, by making use of *the power of specialization,* learned *one* truth, but that truth well.

To those narrow-minded souls who do not believe with us Philistines that "Art is the expression of man's joy in his work," and who say that specialization is a degenerate tendency, I can only say that their cult has existed since all time; "'tis nothing new." We do not feel hurt because of them, but do feel a great load of sorrow for them, that they should so stand in their own light. Their arguments, if such we may call them, have the faculty of tickling the ear, but not moving the soul; to such as fall an easy victim to an oily tongue, they are as sweetest music, but to the discerning ones are but as the chaff around the kernel. Indeed, long ago, in his letter of criticism upon the pseudo-philosophy of Lord Bolingbroke's writings, Edmund Burke has said, "It is an observation which I think Isocrates makes in one of his orations against the sophists, that it is far more easy to maintain a wrong cause, and to support paradoxical opinions to the satisfaction of a common auditory, than to establish a

doubtful truth by solid and conclusive arguments. When men find that something can be said in favor of what, on the very proposal, they have thought utterly indefensible, they grow doubtful of their own reason; they are thrown into a sort of pleasing surprise; they run along with the speaker, charmed and captivated to find such a plentiful harvest of reasoning, where all seemed barren and unpromising. This is the fairy-land of philosophy. And it very frequently happens that those pleasing impressions on the imagination subsist and produce their effect, even after the understanding has been satisfied of their unsubstantial nature. There is a sort of gloss upon ingenious falsehoods that dazzles the imagination, but which neither belongs to, nor becomes the sober aspect of truth. There is an air of plausibility which accompanies vulgar reasonings and notions, taken from the beaten circle of ordinary experience, that is admirably suited to the narrow capacities of some, and to the laziness of others. But this advantage is in a great measure lost, when a painful, comprehensive survey of a very complicated matter, and which requires a great variety of considerations, is to be made; when we must seek in a profound subject, not only for arguments, but for new materials of argument; their measures and their method of arrangement; when we must go out of the sphere of our ordinary ideas, and when we can never walk surely, but by being sensible of our blindness. And this we must do, or we do nothing, whenever we examine the result of a reason which is not our own."

The Arch.

By Grafton Munroe, D.D.S., Springfield, Ill.

For architectural beauty and grace, the mechanic has found in the arch no equal. For, since the day when the Great Builder of the Universe placed His bow in the heavens, man, whatever his inclinations, has had the arch to mark his efforts in the construction of typical buildings and bridges, or the consummation of his efforts in triumphal arches from the days of old Roman heroes, down to those of New York and Dewey.

The human mouth is built as a vault spanned by an arch, and when in repose, two concentric arches carry the teeth, which, when in proper occlusion, do the best work in rendering mastication of the food most perfect. Built after nature's own plan, why should we not find in the regulating arch the most appropriate form for adjusting irregular teeth? The history of the arch dates back to 1726, when

Fauchard, of France, gave us, by the introduction of this device, a life toward that form of appliance distinguished by simplicity—efficiency, ingenuity, and other requisites which mark completeness—found in what is familiarly known to us as the Angle regulating arch.

Most operative dentists are acquainted with the beginnings of what, for a number of years, was so useful in the condensation of gold in the filling of teeth—the Bonwill electric mallet. The enormity of size and comparative unwieldiness of this latter instrument are brought before the essayist's mind when he contemplates the next addition to the arch suggested by Fox, nearly a century later in 1803—consisting principally of the gag, in form of blocks of ivory to prevent the closure of the jaws and interference from moving teeth. The next step was not marked by any particular improvement in the arch, but rather a slight advance, in the attachment of the arch by clamp bands, affording better anchorage, and was given to devotees of orthodontia by Schange in 1840. It consisted of a ribbon of metal nearly encircling the crown of the tooth—the ends bent at right angles—then thickened and perforated—one threaded, the other smooth; a threaded shaft was made to engage the ends, and by turning the shaft, the band was drawn tighter on the tooth.

To Schange also belongs the credit of the introduction of the screw, in regulating appliances, though the honor has sometimes been claimed by Dwinelle, of New York, and Gaines, of England. In 1850, Harris offered some changes in the attachments for the arch. Metal-swaged caps adjusted to molars as abutments for the arch to which it was soldered, and which were kept in place by a plate over the vault, the crowns being soldered to the plate, constituted his ungainly appliance, for it had to be removed for cleansing, and hence lost the requisite quality of fixed anchorage.

When we take into consideration the various forms and deviations from the ideal arch as directed by the Angle System and classification of malocclusion, and contemplate Farrar's elaborate appliances, Patrick's ingenious designs, Byrne's Band Regulators, Jackson's Cribs, Matteson's Crowns, Coffin's Spring Plates, Talbot's Coiled Springs, we are in each reminded of the necessity for closer approach to simplicity.

While most of these appliances may have had a degree of efficiency, yet the elaborateness of design and want of application by systematic classification with a view to the great laws of occlusion, have rendered them only more perplexing to others than to their respective inventors. The method of inventing appliances for each case has given a field for the exercise of individual ingenuity, and even

the Case method uses the operator's time in making screws and taps, and in producing appliances that are far from being marked by simplicity, though perhaps in his hands not inefficient. For, says Dr. Case, in a paper before the Illinois State Dental Society, in 1898, Because of the need of individual direction in the workings of his own appliances, many of these appliances which he has invented and of which he has described the action, to the minutest detail, describing and presenting models of case after case, where they have performed marvelous results in his own practice, have not met with similar results in the hands of others.

As late as the year 1887, Dr. N. W. Kingsley is reported as having said in reply to the query, "What kind of a fixture do you use *now* for regulating teeth?" "I cannot regulate teeth with any one fixture. Some variation of an old appliance must be invented for almost every case. I once started out with the idea—it seems idiotic as I think of it now—that I could publish descriptions of a sufficient number of cases to cover the whole ground of regulating, enabling anyone who came after me to hunt up the particular case that met his need, and find the treatment fully described. But the more I went into it, the more hopeless the task became. It is simply impossible."

With these words of Dr. Kingsley before us, it is no wonder that we heard so little of failures, for each inventive genius could direct his own impractical theories and machinery, placing no dependence in the laws of occlusion and the classification of malocclusion. Thus Farrar, with his complicated network of springs and pulleys had no failures; Talbot, with piano wire, was equally successful; Jackson, with his cribs and split plates, accomplished wonders. All of these earlier workers in orthodontia paid but little heed to the importance of fixed anchorage. It was the genius of the man after whom the plain band was called, that gave us that addition to the arch, which has made the name Magill honored and cherished.

Anchor Bands.

Dr. Magill, of Erie, Pennsylvania, in 1871 or '72, first commenced attaching the plain bands by means of cement, thus obtaining an important step in the laws governing the correction of irregular teeth—namely, fixedness of anchorage.

Believing that scarcely any one here is not acquainted with the making of these bands, I will simply state that they were originally made of platinum or gold of No. 32 or 36 gauge, and, after soldering, were fitted to the tooth: after trimming, were readjusted with cement for the purpose of stationary anchorage for the arch. To Dr. Edward

H. Angle belongs the honor of the introduction of German silver for these bands, and with this metal of the proper thickness, the banding of teeth becomes a task so simple, compared with the original method, that the appliance deserves the name Angle-Magill band.

As the days of "Tinker Regulating" are fast passing into history not to be repeated, and we are living in the time of methods which recognize the practicability of fixed and standard forms of devices, these forms having been arrived at by careful experimentation and close observation in a very large number of cases, covering almost every possible variety of malocclusion, we can appreciate the words of Dr. Farrar, Volume XX, *Dental Cosmos,* when he predicted the possibility of this plan, as follows:

"It has for some time been evident to me—though by most people thought to be impracticable—that the time will come when the regulating process and the necessary apparatus will be so systematized and simplified, that the latter will actually be kept in stock in parts and wholes at dental depots, in readiness for the profession at large, so that it may be ordered by catalogued numbers to suit the needs of the case; so that by a few moments' work at the blow-pipe in the laboratory the dentist may be able, by uniting the parts, to produce any apparatus, of any size, at a minimum cost of time and money."

Thus far it has not been the desire of your essayist to weary you with the details of a text-book description of individual methods, but it seems that all the more prominent plans of regulating have employed as the next most important adjunct to the band as abutment for the arch, that all-powerful agent, the screw, and the distinctive application of the screw in the form of attaching it to bands by means of pipes, is a just claim of our worthy confrere, Dr. E. H. Angle.

When our attention is fixed on the requisites which a regulating appliance should possess, namely, efficiency, simplicity, delicacy, yet power, inconspicuousness and stability of attachment, and then consider the arch with its adjuncts, as advised in the Angle system of regulating, is it not reasonable to say that we have in it the nearest approach to the demand for one that is of universal application?

Let us then divert our attention to a few, at least, of those forms of the *arch* which may be considered as leading up to the system just named.

Labial Bows.

Labial bows extending along the buccal or labial surfaces of the teeth are among the oldest appliances for attachment of ligatures or rubber bands for moving teeth. The ends of the bow have been fastened in

various ways—by ligatures, by imbedding in a plate, by soldering to bands or cribs, or by insertion in tubes soldered to bands or vulcanized into plates. The bow was, and is made of a flat strip of plate, or of round or half-round wire. Dr. Kingsley used round wire attached to vulcanite plates; he also records in his work a case where expansion of the entire arch was accomplished by rubber wedges; imagine the sensation in the act of mastication and the dangers accruing because of the wedges slipping against the gum festoons.

Dr. Bonwill describes two flat bars of platinized gold sliding over each other for at least two inches, and a rubber band fastened to the end of the bar by contracting acts as an expanding agent. The attachment of these bands are made on either side to a bicuspid or molar, as the case permits.

Dr. Byrne's method is described as being dependent upon the power derived from elasticity or corrugated metal bands, formed into a spring or series of springs, so adjusted as to bear most powerfully upon the misplaced tooth or teeth. These bands are made from gold plate 20 to 22k. fine, rolled thin, and when greater power is desired, used double.

Slightly earlier than the above, Dr. Patrick, in 1882, introduced his method of regulating, not requiring any preliminary study of models, not even taking impressions of the case. The appliances were well made, but intricate, consisting of half round bar of platinized gold, adjustable anchor bands, and numerous devices for engaging with the teeth to be moved.

Comparatively so little use is now made of the vulcanite plates with Talbot springs, or the Coffin split plates, that a description seems almost a rehearsal of the obsolete. Suffice it to say, that they have served their office in leading up to something better.

Dr. L. P. Haskell, of Chicago, in the report of the Ninth International Medical Congress, Dental Section, says of the Angle System of Appliances: "They are so few and simple, so small and delicate, and withal so effective, especially as they dispense with rubber plates, that he wished every dentist could at least see them," and with these words as my incentive, placing in the background my own individual proclivities, I wish to give my further attention to this System of Regulating, especially the arch.

Angle's Arch.

The arch, as referred to, is constructed of the metal known as German silver, which, since its introduction about fifteen years ago by Dr. Angle, has nearly supplanted all other metals for the manufacture of regulating appliances. It is a very elastic round bar

of about No. 16 gauge, bent to approximate in form to the outside of an ideal dental arch. Towards the ends on each side it is threaded and provided with friction sleeve nuts, these fitting in turn into the smooth bore tubes of anchor-clamp bands X or D. This constitutes what is known in this system as the arch E.

An arch of similar form and make, except that it is not threaded, but will fit in the clamp bands, sliding as the movements require, when its use is indicated, is known as arch B, and is provided with small collars, about midway the length of each side—for the attachment of rubber ligatures tied and stretched over the tubes of the anchor bands—thereby preventing the teeth from springing back from the positions gained while wearing the more powerful appliances of bar and head gear.

The bar "A," being used mainly in connection with arch "B," to which it is attached by a ball on arch "B" and socket receptacle on the bar "A," this latter appliance does not call for our special attention in a description of the arch.

Wire Ligatures.

Having endeavored to make plain the importance of the requisite of fixedness of anchorage, I can say that this system which has been chosen as our ideal, has that quality pre-eminent, the power obtained in the moving of the teeth is transmitted from the arch to the individual teeth by the use of wire ligatures—than which there is no more important adjunct in the correction of irregularities of the teeth.

Previous to 1895, ligatures consisted mainly of rubber or knitting or waxed floss silk.

The inventor of our ideal system had an eye for simplicity, cleanliness and strength, when in the year just mentioned he introduced the brass wire ligature, though he had used it and thereby had tested it for several years previously. The wire should be of No. 26 gauge, soft in temper, and of sufficient length to give good purchase when making the attachments by twisting.

Simple as this ideal arch for regulating is, in its make-up and principle, it has within its power the capabilities of wonderful expanding force, and not only expanding force, but by its aid a tooth may be moved, labially, buccally, lingually, rotated, elongated, and also even depressed and occasionally moved mesially or distally. The field for study of the application of force is wonderfully large, even though contained in so beautifully simple an appliance.

The use of spurs soldered to the arch with soft solder, and the use of the wire ligatures in securing the desired movement of the

teeth, are grandly unique, and call forth in their proper placing a degree of skill, in which the student of this line of work delights to engage.

The results of the wonderful application of force as transmitted through the use of the arch, are evidenced in the ingenious method evolved from the student mind of Dr. Baker, of Boston, who employed a novel method of exerting force for the reduction of protruding upper incisors, using as anchorage the teeth of the lower jaw and exerting force by means of heavy elastic ligatures, secured at one end to the collar always found on arch "B," and the other end drawn back and passed over the dental ends of tubes of bands "D" on the lower molars.

To use the word of the author, of the latest work on the treatment of malocclusion of the teeth, "the modifications of form and directions of spring, plus the modifications in ligature attachments, make it possible to derive wonderful combinations and results, and in its use it is possible to cultivate a very high degree of skill.

It typifies efficiency and simplicity. It is easily applied, and it is so stable in its attachments, that there need be no slipping or loss of power. It is cleanly, and occupies a position in the mouth that is of least inconvenience to the patient. In its proper use the widest range for reciprocal anchorage is possible. We may also gain simple and a considerable degree of stationary anchorage by reason of the tubes and firm attachments of the anchor band to the teeth used as anchorage."

A description of any of the more recent forms or systems of regulating, insofar as they profess to be new systems, would carry us back to the realms of tinker regulating, adjusting the numerous appliances to each individual case instead of relying upon the principle of that system which is based in its application upon the grand laws of occlusion and the classification of malocclusion set forth in the three great classes with their subdivisions.

Any system that claims to be absolutely without failures in the hands of all employing that system is apt to belong to those whose natures would be classed above those of mortals who err; but the system that has brought the arch into such prominence is just in its claim of being ideal.

In concluding, let me sum up some important reasons why this ideal system is rightly so called.

First.—It does away with plates covering the roof of the mouth.

Second.—It is based upon exact rules and principles.

Third.—Stationary anchorage is a foundation stone.

Fourth.—Being of simple construction, any careful patient can be cleanly.

Fifth.—Material of which it is constructed is not expensive.

Sixth.—Use of blowpipe makes any alteration for obtaining any desired position possible to the operator of mediocre ability.

Seventh.—It is not unsightly or cumbersome, and in its well directed use need cause but little pain.

Is Orthodontia Justly Represented by Its Teaching?

By Lloyd S. Lourie, D.D.S., St. Louis, Mo.

In times of prosperity there is often a tendency to be forgetful or careless of weaknesses. In fact, under the excitement due to success, there is frequently a feeling of enthusiastic satisfaction which resents even the suggestion of criticism. However, were it not for the critic, the remedy of defects would be much slower, and progress delayed accordingly.

Recently there has been a great increase of interest in Orthodontia, as is evident from the amount of discussion it occasions in dental societies and journals, and further by the development of college courses for teaching it. Now beneath all of this attention is there a true conception of the subject? There is certainly a recognition of its need, but is there an understanding of the extent and grandeur of the subject and of its marvelous possibilities, or is the present interest largely such as is caused by things mysterious or difficult to comprehend? We may get some idea of the matter by a consideration of common practice in this branch of dentistry.

The majority of dentists consider cases of malocclusion "good things to let alone" and handle them in that procrastinating way which advises delay of treatment, hoping that in the meantime something will occur to relieve them of the necessity of attempting correction. Patients are put off with these same old wise sayings, "Just let nature alone and she will improve matters," or, "Wait till the twelfth year when most of the teeth being erupted, a more intelligent decision can be made." Slight irregularities are not treated and the initial stages of complicated cases are

allowed to pass unnoticed. Then, much as it has been harped upon, "injudicious extraction" is still at its baneful work.

So much for a glance at the negative practices. The positive practices, or attempts at correction, are possibly more disastrous, for in more instances they work irreparable injury. A large proportion of effort in this line shows an utter ignorance or disregard of the principles of occlusion and consequently of the requirements of the case in hand. Temporary teeth are removed to make room for adjoining permanent ones. Permanent teeth are extracted and the patient assured that the resulting space will close nicely. Teeth in one arch are adjusted with no consideration of the opposing arch. The effect upon the facial lines seems generally to be a minor consideration or not thought of at all, unless there is a marked deformity, and shameful are the afflictions thereby imposed upon innocent patients.

Now, if only the older dentists were guilty of these practices, there would be no need for alarm, but modern dentists, even recent graduates, are included among the offenders.

Where lies the cause of this condition of affairs? I believe much of the responsibility may be placed upon the teaching of orthodontia, for if even its foundation truths were known, such blunders would not be prevalent.

Many persons are prejudiced by first impressions, and there are few who are not greatly influenced by ideas received at college. They naturally suppose that the school teaches the best that is known in its various departments. If, then, orthodontia is misrepresented by its treatment in dental colleges, we may expect those wrong ideas to be prevalent among those who have been under their influence.

Is orthodontia misrepresented by its present teaching? There is quite a diversity in the plans of treatment of the subject by the various schools. There are but two or three which do not claim to pay some special attention to orthodontia, and the school must be very unprogressive that does not recognize it at this day. It is not lack of consideration, but consideration along wrong lines that is working injury.

Faulty Teaching.

The general plan is to try to teach almost all that has been done or attempted and all the theories at present advocated. Along with this there is the technical work of making all kinds of appliances, ancient and modern, simple and complicated. For proof of these statements one has but to look at the text-book most generally approved for this study, or read the references to this department in college announcements. In other departments of dentistry the best is selected and taught

thoroughly, and why should it not be so with orthodontia? The student is presented with a chaotic mass of information and conjecture, and it is no wonder that he often becomes disgusted and prejudiced, or bewildered and misled. He receives wrong impressions in the beginning, and orthodontia is to him a complicated study of invention and experiment. In attempting too much, little is accomplished but confusion. Many things are interesting and valuable as general dental information, or in a special study of the subject, but it is not practicable to teach them to students preparing for the general practice. They certainly have enough to learn that is actually necessary, without being burdened with anything further. Important facts and basic principles are crowded out of mind by the excess of details.

Orthodontia is properly a specialty and to be thoroughly mastered must be studied as such by those specially interested in it and adapted for it. What the dental student needs is a thorough familiarity with the principles that will enable him to detect and diagnose cases which come under his observation; also an understanding of some system for correction and a working knowledge of the necessary appliances.

Some will say that principles are taught, and thoroughly, too. Well, the physiology and dynamics of tooth movement and the etiology of irregularities usually comprise the principles taught, and one may be quite familiar with the teaching along these lines and yet be unable to intelligently diagnose a case of malocclusion or know the changes necessary for its correction. He may be able to accomplish the tooth movement to him apparently necessary, and yet make a serious blunder and failure because, in his planning, there was no consideration given to the requirements of occlusion. In teaching principles, little, and often nothing, is said of occlusion, yet without it there can be no proper conception of orthodontia.

One of the greatest hindrances to a popular understanding of orthodontia has been the lack of system and practically all of the system and logical classification at present is the result of a careful study of occlusion. I believe that the Angle classification of malocclusion is a great step in simplifying the subject, and it is to be hoped that it may soon become more generally known. Without such a basis for reasoning, diagnosis is largely guesswork and consequently faulty.

A potent factor in the misrepresentation of orthodontia is the course of technics generally used in its teaching, and the whole curriculum of dental study contains nothing that is more of a failure. This course has developed almost too rapidly, probably as a result of the recent agitation of the advantages of technical work in general, and the desire for an extensive course seems to have been so great as to overshadow the neces-

sity for a useful one. The mechanical is excessively magnified to the detriment of all else, while the importance placed upon appliance-making is serving to perpetuate that primitive type of orthodontist who relies upon his natural mechanical ability rather than upon scientific research and broad thinking.

The Making of Appliances.

Why is it not time that appliance-making for orthodontia should be relegated to the artisan, as has been the making of instruments for other branches of dentistry? The making of the "principal appliances" is no more a part of orthodontia than is instrument-making a part of operative dentistry, and yet students are required to make all kinds of contrivances from the raw material. Most dental schools are proud of the detail in their course in technics and are pleased to make such announcements as the following: "Our students are required to make all kinds of simple appliances and at least one complicated appliance;" "each student makes the chief appliances of six different authors on orthodontia;" "the student in this department is familiarized with the construction of the various forms of appliances used in the correction of irregularities of the teeth and jaws by being taught in the technic laboratory to make each part of every appliance commonly used."

Others who do not make such plain announcements have even worse ordeals in store for the unfortunate student. Long lists of requirements are arranged, providing for the making of taps, nuts, bolts, bands, and a great variety of combinations, and all from crude material and by hand work. The following is a list of requirements in one school and shows the character of the usual course in orthodontia technic:

"Students in the Freshman year do not receive any instruction in orthodontia. In the Junior year they receive from eight to ten Demonstrative Orthodontia Technic Lectures, and are reouired to construct and deposit the following: Six decimeters of No. 30 wire, drawn from No. 15; two Magill bands 3 mm. wide, one with hook and one with wire loop; six cm. of No. 23 wire, three cm. of which is threaded and three plain; one tube drawn over No. 22 wire, three cm. long and soldered; Magill band with tube, length of tube being equal to the mesio-distal diameter of the crown of the tooth banded; one square headed screw one cm. long, head two mm. long and one and seventy-five hundredths mm. square; two square nuts, same dimensions as head of screw; one round headed screw one cm. long, head two mm. long, one and twenty-five hundredths mm. in diameter, with a hole through head for turning; two octagonal nuts two mm. long and one and seventy-five hundredths mm. in diameter; small wrench one dm. long to grasp square headed screws or nuts; one

jackscrew three cm. long, and one traction screw four cm. long; two adjustable Magill bands, one for molar and one for bicuspid; one small key about four cm. long, with tapering shank to fit square headed screw. All of these pieces, except the wrench, which is of steel, are made of German silver, highly polished before being deposited. Also one copy of a practical piece, consisting of a retraction arch passed through tubes on molars mounted on neatly trimmed, well paraffined model.

"In the Senior year they receive fifteen lectures devoted exclusively to the theory and practice of orthodontia, also five Demonstrative Orthodontia Technic Lectures, and are required to construct and deposit the following: One traction screw, mounted on natural teeth imbedded in plaster of paris, extending from molar to cuspid to cause partial rotation and retraction of cuspid; one jackscrew from bicuspids at one side to lateral incisor of opposite side, producing forward movement of the lateral. This appliance is also mounted on natural teeth imbedded in plaster of paris; also copy of a complicated device mounted on a neatly trimmed, well paraffined model.

"Under the personal supervision of the instructor in orthodontia, the Senior class conducts several practical orthodontia cases in the infirmary, the appliances constructed and mounted by members of the Senior class."

Is it any wonder that orthodontia should be considered irksome? Is it strange that it is supposed to require an unprofitable expenditure of time and patience? Such work is in no way agreeable to the students' idea of dentistry, and rightly should not be. Few men have the ability to invent and construct appliances as needed in practice, and if they had, few could spare the time to do it when the market offers much better ones ready made. Good and useful appliances are often put in disrepute by the use of poor imitations of them.

Present methods of teaching do not justly represent orthodontia, for they so frequently cause an aversion to its study when it should be most fascinating, even to its difficult problems. There is ample evidence that the present course is giving to the student of dentistry little that is of real value in practice, and it would seem advisable to teach less, and to teach more thoroughly that which is important and really necessary.

Occlusion, being the very foundation, should be given the first consideration, and that over its whole scope. With a knowledge of its principles and a thorough appreciation of their far-reaching possibilities, there is less need for consideration of problems otherwise difficult of solution. For instance, the problems of extraction will no longer require a special set of rules, for it will be practiced only as a last resort. The development of the teeth and jaws, the causes of malocclusion, and the physiological changes during and subsequent to tooth movement should, of course, receive due attention.

The best plan of treatment for various conditions should be selected and classified to form a guide for corrective procedure. The unnecessary construction of appliances must in the near future be abandoned and, at present, most of the requirements in that line should be dispensed with, especially those that can be made by the mechanic to advantage. A working knowledge, rather than a constructive knowledge, of appliances is necessary and can be afforded in abundance by clinic cases.

The making of models from plaster impressions should be a part of the course in technics, as they are the nearest approach to accuracy, and any but accurate models are of little value and often positively harmful, for they are untruthful.

It is of the very first importance that students of dentistry should be given such instruction as will form a basis for intelligent diagnosis and prognosis. They should have that if nothing more.

The Four Intermaxillary Bones, Hare-Lip and the Morphological Value of the Upper Incisor Teeth of Men.

By Prof. Paul Albrecht, Doctor in Medicine, Surgery and Accouchement, Doctor in Philosophy.

(Translated from the French by Miss Dorothy K. Pearsall, May, 1901.)

Read before the American Society of Orthodontists, at St. Louis, Mo., June 12, 1901.

In all mammals the upper incisor teeth are imbedded in a particular bone, *the intermaxillary or incisor bone.* Galen* was the first to recognize the presence of this bone in man, a discovery not contested until the time of André Vésale. This great reformer of human anatomy showed that the works of Galen were based solely upon dissections of monkeys and dogs and that man did not possess the bone in question.†

This idea of Vésale of the non-existence of the intermaxillary in man existed down to the time of Goethe and of Oken. The former showed that in the double hare-lip the intermaxillaries remained isolated, forming the *bourgeon*, whilst ordinarily they united in good time with the upper jawbones. This theory of Goethe was accepted without opposition until recently. Meanwhile I pointed out in a short notice published in 1879 in the *Zoologischer Anzeiger* that in reality there exist four intermaxillary bones, two on each side of the central plane, and that the cleft of the hare-lip does not pass between the intermaxillary and the upper jaw, but that it is "intra-incisive," or, rather, that it passes between the two intermaxillary bones of one side. The following are the differences between Goethe's theory and mine:

1. According to Goethe's theory, there are two intermaxillaries in man. According to mine there are four.

2. According to Goethe's theory, the *bourgeon* in the double hare-lip is formed by the two intermaxillary bones. According to my theory the *bourgeon* is formed by two internal intermaxillary bones.

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*Salenus lib. De Ossibus, Chap. III.
†Vesalius De Humani corporis fabrica lib. 1, Chap. IX.

3. According to Goethe's theory, the cleft of the hare-lip is situated between the intermaxillary bone and the upper jaw. According to my theory the cleft is situated between the internal intermaxillary bone and the external intermaxillary bone.

4. According to the theory of Goethe and his followers, it is impossible that the incisive suture and the cleft of the hare-lip should exist on the same side. According to my theory the thing is quite comprehensible and it is one that always does exist, provided that the incisive suture be not obliterated.

5. According to the embryologists, who admit Goethe's theory, the cleft of the hare-lip corresponds to the cleft between the submaxillary *bourgeon* and the internal nasal *bourgeon*. According to my theory the

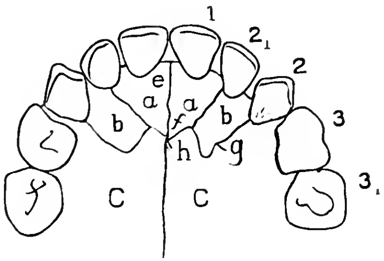

Fig. 1.

Fig. 1. Albrecht's Theory. The intermaxillary sutures of a child. aa, Endognathion, right and left; bb, Mesognathion, right and left; cc, Exognathion, right and left; e, Interdognathic suture; f, Endomesognathic suture; g, Mesoexognathic suture; h, Endoexognathic suture; i, Internal incisor deciduous (central); 1^1, External incisor deciduous (lateral); 2, Canine deciduous; 3, First molar deciduous; 3^1, Second molar deciduous.

cleft of the hare-lip corresponds to the primitive cleft between the internal and external nasal *bourgeon*.

6. According to the embryologists who are followers of Goethe's theory, the internal nasal *bourgeons* form the intermaxillary bones, whilst the submaxillary *bourgeons* give birth to the upper jaw bones. According to my theory the internal nasal *bourgeons* form the internal intermaxillary; the external nasal *bourgeons,* the external intermaxillaries; the submaxillaries, the upper jaw bones.

In the normal state the four intermaxillaries unite between themselves and join with the upper jaw bones, giving birth to a complex system of sutures. In order to be able to designate these sutures conveniently, I used in my work to which I previously alluded, the following Greek names for the three bones that hold the upper teeth in man. I called the

internal intermaxillary bone the endognathion (ἐν γνάθος, the jaw), the external intermaxillary bone, the mesognathion, and the upper jaw bone, the exognathion.

We have then in Fig. 1;

(1) Between the two internal intermaxillary bones, the interendognathical suture. (Fig. 1, e.)

(2) Between the internal and external intermaxillary, the endo-mesognathical suture. (Fig. 1, f.)

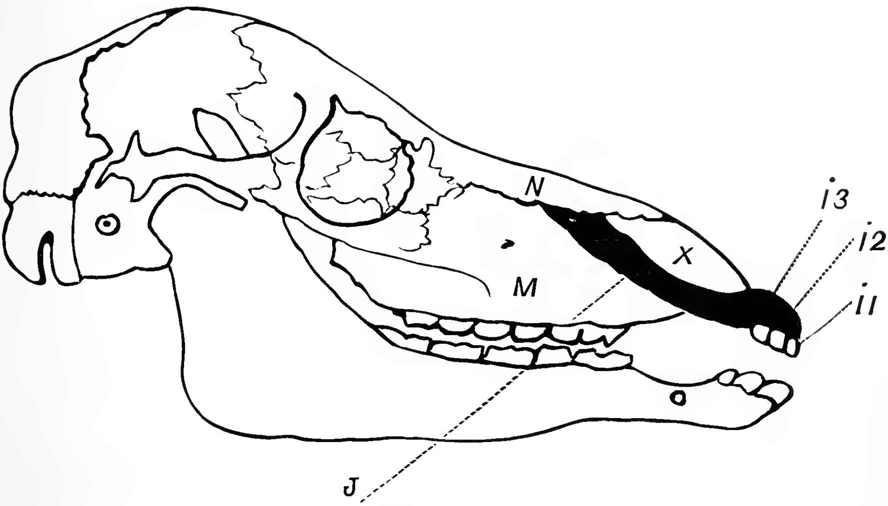

Fig. 2.

Fig. 2. Diagram of right profile of skull of young normal horse—six incisors. J, Intermaxillary bone. M, Upper jaw. N, Nasal bone. X, Quadrilateral cartilage of the partition of the nose. i_1, First upper milk incisor. i_2, Second upper milk incisor. i_3, Third upper milk incisor.

(3) Between the internal intermaxillary and the upper jaw, the endo-exognathical suture. (Fig. 1, h.)

(4) Between the external intermaxillary bone and the upper jaw, the meso-exognathical suture. (Fig. 1, g.)

(5) Between the two upper jaw bones, the inter-exognathical suture.

In a normal state in man the upper central incisor tooth develops in the internal intermaxillary bone or endognathion, and the upper lateral incisor tooth develops in the external intermaxillary bone or mesognathion.

Recently the son of the great embryologist, A. Von Kölliker, M. Th. Kölliker, published a memoir in which he vehemently contested my theory put forth in 1878, conducing to re-establish Goethe's theory; consequently he accepts two intermaxillary bones only, and maintains that in the hare-lip the cleft of the alveolar apophysis is always between the intermaxillary and the upper jaw.

We have already seen that all mammals possess the intermaxillaries well developed and distinct until adult age, whereas in man, where the face is reduced, they are smaller and united with one another and with the upper jaw, as early as the eighth week of embryonic life. It is clear

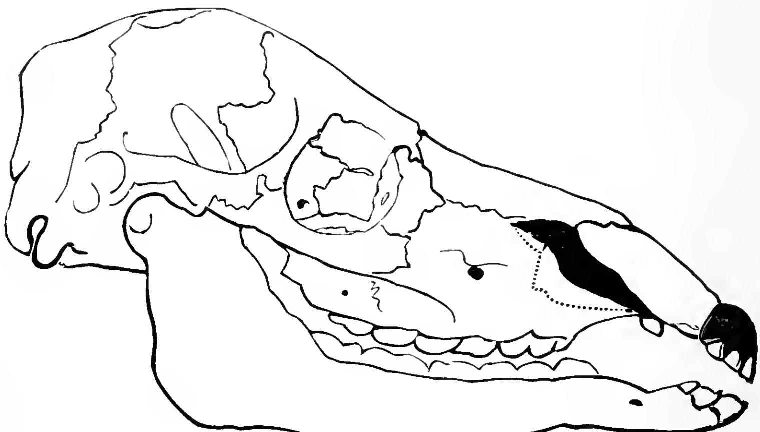

Fig. 3.

Fig. 3. Diagram of the right profile of a young horse affected by double hare-lip—eight upper incisors. J_1, Internal intermaxillary bone. S_{11}, External intermaxillary bone. M, Upper jaw. N, Nasal bone. X, Quadrilateral cartilage of the partition of the nose. i_1, First upper milk incisor. i_2, Second upper milk incisor contained in the internal intermaxillary bone. i_3, Third upper milk incisor. i_4, Fourth upper milk incisor contained in the external intermaxillary bone. X, Mamillary cleft between internal intermaxillary bone and external intermaxillary bone. S, Incisive suture between external intermaxillary bone and upper jaw.

then that it is necessary to begin the study of intermaxillaries in animals in which they are most developed and most distinct. Such for example is the horse, which we shall choose first.

Now by a strange coincidence I found, in 1878, in the skull of a horse affected with double hare-lip, the existence of four incisive bones. I show you here the right diagrammatic profiles of this skull, comparing it with the same profile in the skull of a normal horse. (Fig. 2.)

In the normal horse the intermaxillary bones possess an extensive body and two processes. The one is the palatine process, which, joining to the same organ on the other side, touches the palatine processes of the upper maxillaries. The other, the nasal process, which borders outwardly on the pyriform opening, unites in all its length with the inner edge of the facial surface of the upper jaw, running as far as the nasal bone, with which it also unites.

We have then two sutures with the nasal process; one intermaxillo-submaxillary suture, and one intermaxillo-nasal suture.

It is evident that the intermaxillo-submaxillary suture is nothing but the facial part of the incisive suture of the human anatomy.

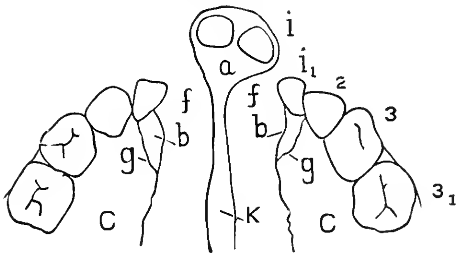

Fig. 4.

FIG. 4. Diagram of the double hare-lip in man, with double palatine cleft. a, The two internal intermaxillary bones joined together on the medium line (endognathion, right and left). bb, The two external intermaxillary bones (mesognathion, right and left). cc, The two upper maxillary bones (exognathion, right and left). ff, Lateral maxillary clefts between the internal intermaxillary bone and the external intermaxillary bone (endomesognathic fissure). gg, The two incisive sutures between the external intermaxillary bone and the upper jaw (mesoexognathic suture). k, Vomer. 1, Internal incisive milk tooth. 1^1, External incisive milk tooth. 2, Canine milk tooth. 3, First molar milk tooth. 3^1, Second molar milk tooth.

Each intermaxillary bone in the horse carries three incisive teeth, two of which are lodged in the body and one where the nasal process takes its origin.

This being admitted, we shall proceed to the examination of the hare-lip of the horse.

I had the chance of finding in the teratological collection of the Anatomical Institute of the University of Königsberg a horse's skull with a double hare-lip. (Fig. 3.)

As at that time I still shared the theories generally taught, I was very much surprised at not finding the cleft of the hare-lip between the intermaxillaries and the upper jaw, but between the body of the intermaxillary and its nasal process.

In fact, we see when we look at the right diagrammatic profile of this horse, the nasal process uniting exactly as it does in the normal horse, with the upper jaw.

We find then in this case the intermaxillo-supramaxillary suture, and at the same time on the same side of the skull the cleft of the hare-lip.

This suture, counting from the point where the nasal apophysis of the intermaxillary, the upper jaw and the nasal bone touch each other, to its lower extremity, measuring on the left eighty millimetres, on the right seventy-nine millimetres.

The cleft between the nasal process and the body of the intermaxillary, measuring from the palatine surface of these organs, is on the left eleven millimetres, on the right twenty millimetres.

It is then incontestable that we have here on both sides of the skull a co-existence of the intermaxillo-supramaxillary suture, or incisive suture and the cleft of the hare-lip.

Since M. Th. Kölliker says that the co-existence on the same side of the incisive suture with the lateral maxillary cleft never takes place, I can only regret with him that he has not been so lucky as myself in his researches. I say this with all the greater certainty because the co-existence of these two organs is altogether incontestable in the horse's skull, and especially because these organs leave nothing to be desired when considering their microscopic dimensions, the incisive sutures measuring, I repeat, on the right side seventy-nine millimetres, on the left eighty millimetres.

There is no doubt that the part of the intermaxillary situated laterally to the cleft and which borders on the outside of the pyriform opening is our external intermaxillary, the mesognathion. This external intermaxillary has on the left a fourth incisive tooth, that is to say, a supernumerary tooth, since the body carries three on each side.

On the right this incisive tooth does not take root in the bone but is situated immediately below it, implanted in the dry mucous.

On the internal side of the cleft we find the two internal intermaxillary bones (endognathia) united to the facial side, but still joined by suture to the palatine face.

These two internal intermaxillary bones carry together six incisive teeth three on each side.

The two first are well placed. The second and third have an abnormal direction, especially the second on the right, whose cutting edge points outwards. This tooth has suffered a rotation of 90° round the axis of its root, then has righted itself from 90°.

We have here then eight incisive upper teeth, a rare thing in the horse.

The explanation of the morphological value of these teeth will be given to us hereafter by two extremely remarkable skulls preserved in the collection of the Anatomo-Pathological Society of Brussels.

Let us now pass to the hare-lip in man. Generally the double hare-lip in man presents itself under the form of this diagram. (Fig. 4.)

This diagram, which I take from my before-mentioned work, was made in 1878 from the skull of a child here given. When looking at this diagram, we have in the middle the vomer very elongated in front and bearing anteriorly a bone which contains two incisive milk teeth.

Latterly, with reference to the cleft, we find four teeth at each side in their alveoli: the two molars, the canine and an incisive milk tooth.

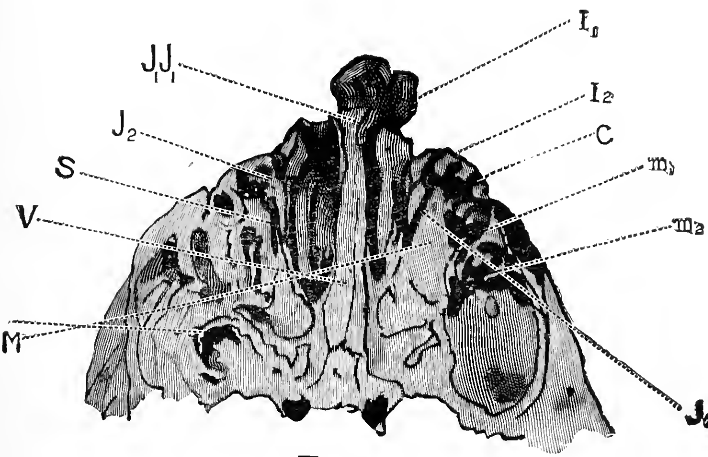

Fig. 5.

FIG. 5. Lingual view of the anterior part of the skull of a new-born child affected by double palato-maxillary cleft—four upper incisors. JJ, The two internal intermaxillaries joined at the middle line. $J^{1\ 11}$, Left external intermaxillary bone. M, Left upper jaw. V, Vomer. I_1, Upper internal incisor (milk dentition). I_2, Upper external incisor (milk dentition). C, Upper external canine (milk dentition). M_1, First upper molar (milk dentition). M_2, Second upper molar (milk dentition). S, Right incisive suture (milk dentition). On each side between the external intermaxillary bone and the upper jaw: the incisive suture. On each side between the internal intermaxillary bone and the external intermaxillary bone: the cleft of the hare-lip.

The cleft is then between the middle incisor tooth and the lateral incisor tooth. The piece which contains the lateral incisor is still separated by a suture very easily seen on the palatine face. There is no doubt that this suture is the seam between the upper jaw and the outer intermaxillary, and that the bone from the upper jaw is the external intermaxillary, whilst the bone which carries the two middle incisors shows us the two internal intermaxillaries joined. If we look now at the skull of a child itself (Fig. 5), we see the proof of what we have shown in our diagram. To the right and left we see the co-existence of the endo-mesognathic cleft of the hare-lip between the internal intermaxillary and the external inter-

maxillary, and of the meso-exognathic or incisive suture between the external intermaxillary bone and the upper jaw. Here is again proven in man the co-existence on the same side of the cleft of the hare-lip and the incisive suture.

In the case of the unilateral hare-lip in man we have on one side alone what we have just verified with two sides. This is what the skull (which I pass round now) shows very clearly. (See Fig. 6.)

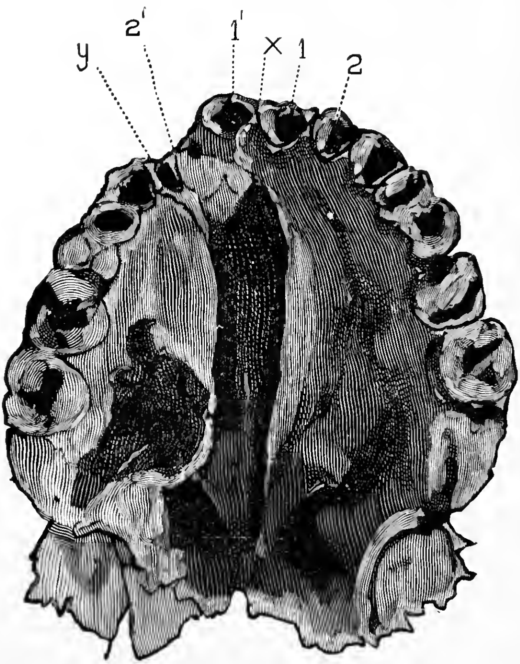

Fig. 6.

Fig. 6. Lingual view of the palate of an adult affected by a hare-lip and of right unilateral palatine fissure, (belonging to the Kiel University). 1, Socket of the left internal incisor. 2, Socket of the left external incisor. 1^1, Socket of the right internal incisor. 2^1, Socket of the right external incisor. Between 1^1 and 2^1 the maxillary cleft is seen. X, Suture between the two internal intermaxillary bones (interendognathic suture). Y, Suture between the right external intermaxillary bone and the right upper jaw (incisive or right mesoexognathic suture).

I owe this remarkable skull to the kindness of Professor Flemming, Director of the Anatomical Institute at Kiel. It comes from an adult man having a hare-lip and a cleft palate on the same side. On account of the hare-lip and the unilateral palatine cleft there were distortions in the long face of this man.

1. The vomer bends very much to the left to form with the palatine apophysis of the upper jaw and of the left palatine bone, the left nasal cavity.

2. The right internal Eustachian tube and the right bony palate descend much lower than the same parts on the left.

The cleft of the hare-lip is, as one can see, between the alveolus of the right internal incisor and the alveolus of the external incisor on the same side.

Then come the alveoli of the right canine, the two premolars and the two first right molars, whilst the right wisdom tooth has been lost during life and its alveolus is reabsorbed.

To the left we have the alveoli of the internal incisor, the external incisor, the canine, the two premolars and the two molars; the wisdom tooth and its alveolus have undergone the same process as the one on the right side.

Between the sockets of the right external incisor and the canine we observe a suture on the palatine surface.

It is evidently the incisive suture between the right external intermaxillary and the right upper jaw, or the meso-exognathic suture. We are then again in the presence of the co-existence of the incisive suture and of the hare-lipped fissure so energetically contested by Th. Kölliker.

The right internal intermaxillary bone which carries the socket of the right incisor is united at the median line with the left internal intermaxillary by a suture which still leaves it a certain mobility. *We have thus here the case of an endognathion (right bone) entirely isolated.* The inter-endognathic suture which is obliterated so rapidly in the double hare-lips has remained open in this adult with the unilateral hare-lip.

I am happy not only to be able to show the presence of an isolated maxillary bone in the skull at Kiel, but I can again add that there is a case in literature in which the external intermaxillary bone of each side was isolated from the upper jaw. This was the case of Mr. J. F. Meckel.

If one wishes to judge the considerable and disastrous effect exercised by the theory of Goethe on the minds of our best anatomists and surgeons, it is enough to compare the figures and text of the eminent German surgeon, Mr. Koenig. If we take the second edition of his Manual of Special Surgery we read (p. 243) the following sentence:

"The simple maxillary fissure *always* passes between the incisor and the canine corresponding to the place of foetal reunion of the intermaxillary with the side parts."

This sentence is accompanied by two figures after M. Von Bruns (Nos. 47 and 48), which show the plainest discordance between M. Koenig's text and his illustrations.

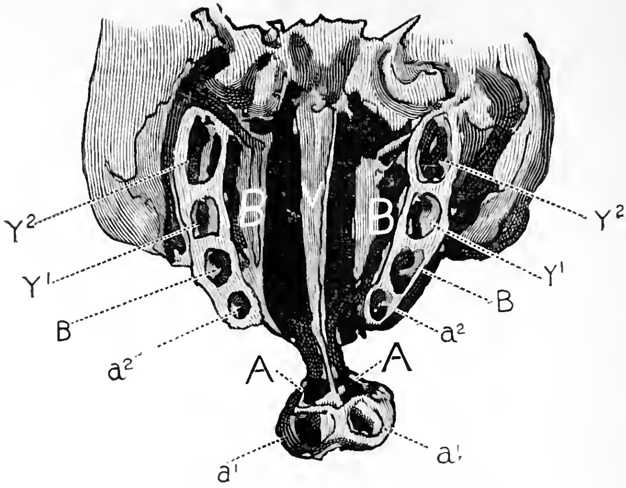

Fig. 7.

FIG. 7. Analysis of Fig. 48, page 244, Vol. 1, of the Second Edition of the *Manual of Special Surgery,* by M. Koenig (double hare-lip in a child after M. Von Bruns). a^1a^1, Sockets of internal milk incisors (centrals). $2^{11}2^{11}$, Sockets of external milk incisors (laterals). BB, Sockets of milk canines. Y^1Y^1, Sockets of first milk molars. $Y^{11}Y^{11}$, Sockets of second milk molars. V, Vomer. BB, Upper maxillaries joined to external intermaxillary bone.

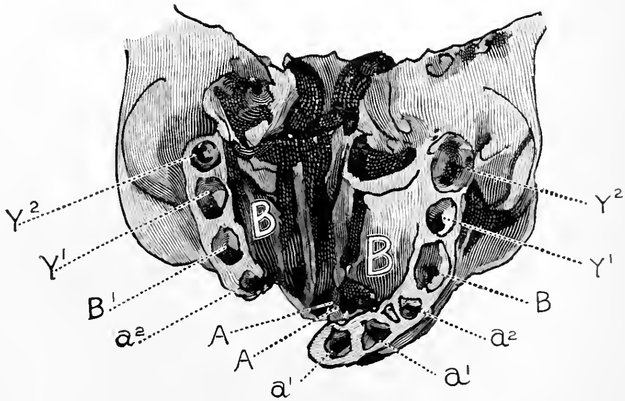

Fig. 8.

FIG. 8. Analysis of Fig. 47, page 243, Vol. 1, of the Second Edition of the *Special Surgery Manual*, by M. Koenig (left unilateral hare-lip of a child, after M. Von Bruns). a^1a^1, Sockets of internal milk incisors (centrals). $a^{11}a^{11}$, Sockets of external milk incisors (laterals). BB, Sockets of milk canines. Y^1Y^1, Sockets of first milk molars. $Y^{11}Y^{11}$, sockets of second milk molars. BB, Upper maxillaries and joined external intermaxillary bones. AA, Internal intermaxillary bones. The interendognathic and the right endomesognathic sutures are still plainly visible.

In fact in the single hare-lip (Fig. 47) as well as in the double hare-lip (Fig. 48), the cleft does not pass between the incisors and the canine, but between the two incisors.

It is evident that the first tooth situated outside of the cleft is not the canine, as Mr. Koenig believes, but the external incisors—you can judge and suit yourselves. I show these figures, Nos. 7 and 8.

It can be seen from the just mentioned examples how much the

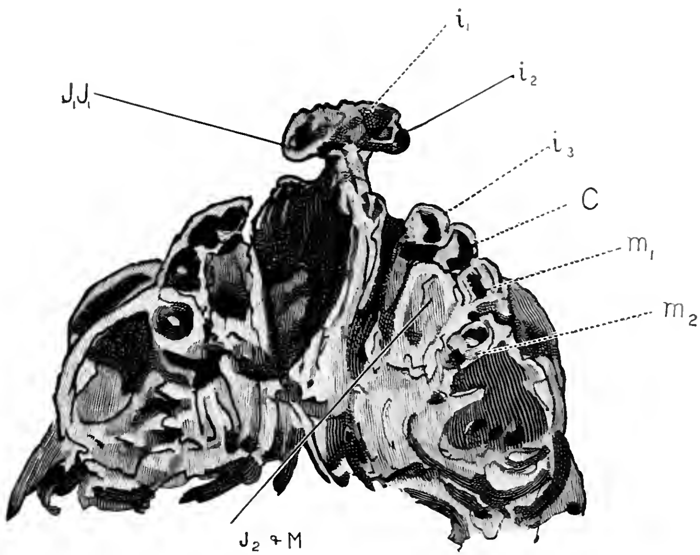

Fig. 9.

FIG. 9. Lingual view of the anterior part of the skull of a child affected by double palato-maxillary cleft—six upper incisors (belonging to the collection of the Anatomo-Pathological Society at Brussels). J_1J_1. The two internal intermaxillary bones joined at the middle line. $J_{11}M$, Left upper jaw joined to left external intermaxillary bone. V. Vomer. i_1, Upper para-symphysian milk incisor contained in the internal intermaxillary bones. i_{11}, Upper propara-symphysian milk incisor contained in the internal intermaxillary bone. i_{111}, Upper milk pre-canine contained in the external intermaxillary bone. C, Upper external canine (milk dentition). M, First upper molar (milk dentition). M_2, Second upper molar (milk dentition).

Goethe theory has been rooted in the most cultivated minds. Mr. Th. Kölliker says in his before-mentioned work, page 364, "My theory reposes on two supports which he believes to have destroyed: 1. The co-existence of the incisive suture with the lateral maxillary fissure. 2. The dependence in which the teeth are found opposite the bones."

Concerning the co-existence of the incisive suture with the external cleft I leave the care of deciding who, Mr. Kölliker or I, is right, to those competent to judge. We have proved this co-existence of the two

sides in the skull of the horse (Fig. 4), and in man (Fig. 5), on one side only in the unilateral hare-lip of Kiel (Fig. 6). As to the horse, the co-existent incisive suture did not measure less than seventy-nine millimetres on the right and eighty millimetres on the left. In human skulls, if not as large, it was at least as distinct.

Now as to what concerns the dependence of the teeth with reference to the bones in which they are planted, I maintain the opinion which I laid out in my preceding work, Mr. Kölliker, in my opinion, having done absolutely nothing to prove the independence of the dentition with regard to the bones which sustain it.

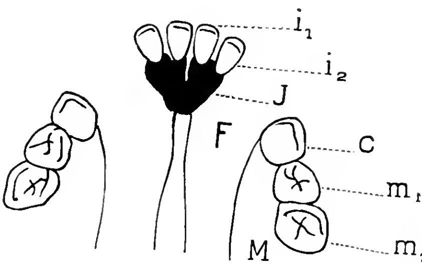

Fig. 10.

Fig. 10. Diagram representing the ancient theory of hare-lips, which maintains that the hare-lip cleft passes between the "intermaxillary" bone and the upper jaw. As according to this theory, the incisiors (i_1i_2) are situated in the "intermaxillary" bone (J), the hare-lip cleft (F) separates the "intermaxillary" (J) from the upper jaw (M). J_1, Left internal intermaxillary bone (left endognathion). J_{11}, Left external intermaxillary bone (left mesognathion). M, Upper jaw (left)—(exognathion left). i_1, Internal upper milk incisor. i_2, External upper milk incisor. i_1, Parasymphysian upper milk incisor. i_{11}, Proparasymphysian upper milk incisor. i_{111}, Pre-canine upper milk incisor. C, Upper milk canine. M_1, First upper molar. M_2, Second upper milk molar.

I shall, however, communicate the very interesting conclusions in regard to dentition to which I have been led by the examination of two precious preparations belonging to the Anatomy and Pathology Society of Brussels. I seize this opportunity to express my best thanks to Mr. Thiry, President of this Society, for the permission which he kindly granted me to examine them and have them reproduced.

In these skulls we establish the presence of four milk incisors in the *bourgeon,* and again an upper incisor on each side of the hare-lip cleft. We have thus here six incisors.

One of the skulls (see Fig. 9) shows us the crowns of four milk incisors which are not yet quite erupted in the *bourgeon* and a third milk incisor on each side of the cleft well erupted. On this skull the incisive sutures are no longer seen.

In the figures I have represented, the ordinary double hare-lip with four incisors (Fig. 11), and the same affection, but with six incisors (Fig. 13).

The following are the distinguishing features of these two cases:

In the double hare-lip with four incisors, each of the four intermaxillary bones carries an incisor. In the double hare-lip with six incisors, the two internal intermaxillary bones each carry two incisors, and the two external intermaxillary bones each one incisor.

Thus the two cases have this in common, that the *external* intermaxillary bone always carries only one incisor. As the external inter-

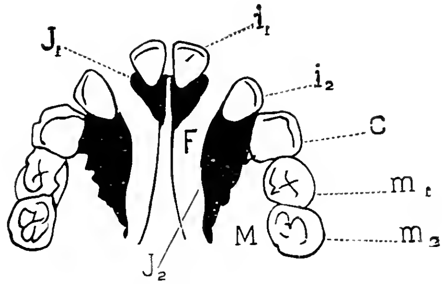

Fig. 11.

Fig. 11. Diagram representing my theory of double hare-lips with four incisors, theory emitted in 1878. The hare-lip cleft (F) passes on each side between the internal intermaxillary bone (J_1) and the external intermaxillary bone (J_{11}); it co-exists on each side with the incisive suture (S), which is situated between the external intermaxillary bone (J_{11}) and the upper jaw (M). The internal intermaxillary bone (J_1) bears on each side the internal incisor (i_1); the external intermaxillary bone (J_{11}) bears the external incisive (i_2). J_1, Left internal intermaxillary bone (left endognathion). J_{11}, Left external intermaxillary bone (left mesognathion). M, Upper jaw (left)—(exognathion left). i_1, Internal upper milk incisor. i_2, External upper milk incisor. i_1, Parasymphysian upper milk incisor. i_{11}, Proparasymphysian upper milk incisor. i_{111}, Pre-canine upper milk incisor. C, Upper milk canine. M_1, First upper milk molar. M_2, Second upper milk molar.

maxillary bone of the hare-lip with four incisors is the homologue of the external intermaxillary bone of the hare-lip with six incisors, it is certain that the incisors which they contain on either side are also homologous. In both cases these incisors are situated in front of the canine and separated from them by the incisive or meso-exognathic suture.

We shall designate this incisor placed immediately in front of the canine by the name of *pre-canine*. The pre-canines are always situated in the external intermaxillary bones.

What is the homology of the incisors contained in the internal intermaxillaries?

Here is presented a difficulty. In fact in the case of the hare-lip with four incisors the internal intermaxillary carries only one incisor,

whilst in the case of the hare-lip with six incisors the same bone carries two of them. But on reflection it is evident that in the hare-lip with six incisors the incisor situated nearest to the median line, that is, the most internal of the two incisors contained in the internal intermaxillary, is homologous to the solitary tooth situated in the internal intermaxillary of the hare-lip with four incisors. We shall call the incisor nearest the median line, or symphysis, of the internal intermaxillary bones, the incisor *parasymphysis.*

The parasymphysian incisors are thus homologous.

The external tooth contained in the internal intermaxillary bone of the hare-lip with six teeth, which I propose to call the *proparasymphysian,* finds no homologue in the hare-lip with four teeth.

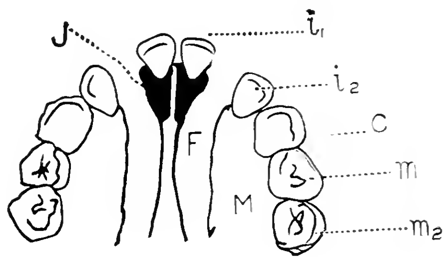

Fig. 12.

FIG. 12. Diagram representing Mr. Th. Kölliker's explanation of hare-lips with four incisors, with one incisor on each side inside and one outside the cleft.

According to this theory, the cleft (F) is, nevertheless, situated between the "intermaxillary" bone (J) and the upper jaw (M), the internal incisor (i_2) being only planted in the upper jaw (M). J, Left internal intermaxillary bone (left endognathion). J, Left external intermaxillary bone (left mesognathion). M, Upper jaw (left)—(exognathion left). i_1, Internal upper milk incisor. i_2, External upper milk incisor. i_1, Parasymphysian upper milk incisor. i_{11}, Proparasymphysian upper milk incisor. i_{111}, Pre-canine upper milk incisor. C, Upper milk canine. M_1, First upper milk molar. M_2, Second upper milk molar.

In the hare-lip with four teeth the parasymphysian is that first incisor; the pre-canine the second.

In the hare-lip with six teeth the parasymphysian is the first incisor and the pre-canine the third.

The theory which I have already established of the morphological value of the upper incisor of the normal man is as follows:

The upper internal incisor, or upper parasymphysian, is in reality the first incisor.

The external upper incisor, or second upper incisor of normal man (upper pre-canine) is in reality *the third incisor.*

The true upper second incisor no longer develops in the normal state, but in the case of the hare-lip with six upper incisors it reappears. This reappearance of the second upper incisor is, according to me, atavic. This tooth being phylogenetically and ontogenetically lost can reappear by atavism in the case of the hare-lip. One can wonder what the cause of this reappearance is. This cause ought to be sought for in the favorable nutrition which the internal intermaxillary bones possess in the case of the hare-lip.

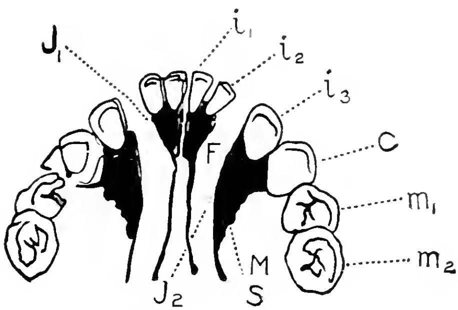

Fig. 13.

FIG. 13. Diagram representing my theory of double hare-lips with six incisors; the hare-lip cleft (F) passes on each side between the internal intermaxillary bone (J_1) and the external intermaxillary bone (J_{11}); it co-exists on each side with the incisive suture (S), which is situated between the external intermaxillary bone (J_{11}) and the upper jaw (M). The internal intermaxillary bone (J_1) on each side bears two incisors; the parasymphysian (i_1) and the proparasymphysian (i_{11}); the external intermaxillary bone (J_{11}) bears an incisor, the pre-canine (i_{111}). J, Left internal intermaxillary bone (left endognathion). J, Left external intermaxillary bone (left mesognathion). M, Upper jaw (left)—(exognathion left). i_1, Internal upper milk incisor. i_2, External upper milk incisor. i_1, Parasymphysian upper milk incisor. i_{11}, Proparasymphysian upper milk incisor. i_{111}, Pre-canine upper milk incisor. C, Upper milk canine. M_1, First upper milk molar. M_2, Second upper milk molar.

To point out what I have remarked and what is well-known to surgeons, that in the double hare-lip combined with the double palatine cleft (*gnatho-uranoschisis duplex*) the vomer developing much more than in the normal state, becomes a bone of great hardness and pushes strongly in front, forming in this manner a prominence to the *bourgeon* formed by the two internal intermaxillary bones. This is the cause of a very great difficulty for the surgical operation of this defect of conformation.

Mr. W. Voolik, in his excellent "Handboek der Ziektekundige outleedkunde," has been the first to perceive the cause of the enormous preeminence of the "intermaxillary in the double gnatho-uranoschisis." He attributes it to the independence of the intermaxillary bone in this monstrosity, since it is not retained by sutures with the upper maxillary bones.

I am able to correct and amplify this theory from the excellent source of Voolik. First in the double hare-lip with the double palatine cleft, the vomer not being arrested by sutures with the palatine processes of the upper jaw, and the internal intermaxillary bones not being arrested by sutures with the external intermaxillary bones, the vomer and the internal intermaxillary bones develop towards the *locus minoris resistentiae*, i. e., in front. In this growth we see precisely the same causes and the same effects as in the growth of the incisors of the rodents, when by chance one or the other of these incisors does not develop or is broken, as in the cases of cyclopean monstrosities of mammals, when by compli-

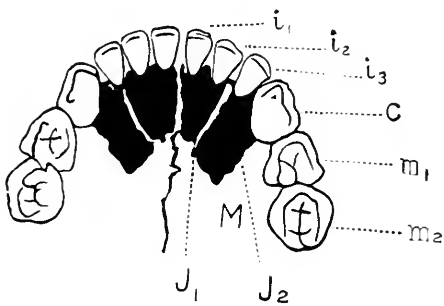

Fig. 14.

FIG. 14. Representing my theory on the dentition of our hexaprotodont ancestors. A milk dentition has been drawn to facilitate the comparison with others. J, Left internal intermaxillary bone (left endognathion). J, Left external intermaxillary bone (left mesognathion). M, Upper jaw (left)—(exognathion left). i_1, Internal upper milk incisor. i_2, External upper milk incisor. i_1, Parasymphysian upper milk incisor. i_{11}, Proparasymphysian upper milk incisor. i_{111}, Pre-canine upper milk incisor. C, Upper milk canine. M_1, First upper milk molar. M_2, Second upper milk molar. The parasymphysian (i_1) and the proparasymphysian (i_{11}) are situated in the internal inmaxillary bone (S), the pre-canine (i_{111}) in the external intermaxillary bone (J_{11}).

cation the upper jaws and the intermaxillary become rudimentary (micrognathy superior), and the lower jaw curves strongly upwards (campylognathic infeneure).

In the simple gnatho-uranoschisis the vomer and the two internal intermaxillary bones possess only on the side of the hare-lip and of the palatine cleft the liberty which is given to them on both sides in the double palato-maxillary cleft, whilst on the opposite side they are retained by the sutures with the palatine, the upper jaw and the external intermaxillary bone. The effect of this unilateral independence is not as great as in the case of the bilateral independence, but it is still rather marked.

I have explained why in the double palato-maxillary cleft, the vomer pushes in advance so strongly, but I have not yet spoken of the causes

which produce in the same case the great development of its bony sub stance and its great hardness.

This is my theory with regard to this phenomena.

In the double hare-lip with double palatine clefts, the arteries which nourish the vomer and the two internal intermaxillary bones do not anastomose directly with the arteries of the upper jaws and external intermaxillaries.

This is why the vomer and the internal intermaxillaries generally become so large in this defect of conformation. I go still further. By

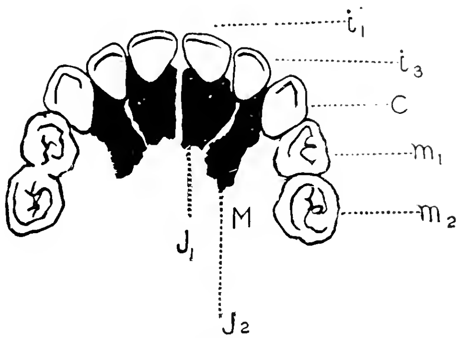

Fig./5.

Fig. 15. Diagram representing the morphological value of the upper incisors of actual normal man. The proparasymphysian or the true second incisor being lost, there only remains the parasymphysian (i_1) contained in the internal intermaxillary bone (J_1) and the pre-canine (i_{111}) contained in the external intermaxillary bone (J_{11}).

The pre-canine or the mesognathic incisor, generally called in man external incisor or second upper incisor, is thus in reality our third upper incisor.

J_1, Left internal intermaxillary bone (left endognathion). J_{11}, Left external intermaxillary bone (left mesognathion). M, Upper jaw (left)—(exognathion left). i_1, Internal upper milk incisor. i_2, External upper milk incisor. i_1, Parasymphysian upper milk incisor. i_{11}, Proparasymphysian milk incisor. i_{111}, Pre-canine upper milk incisor. C, Upper milk canine. M_1, First upper milk molar. M_2, Second upper milk molar.

this enormous growth of nourishment in the internal intermaxillary bones teeth can develop atavically that in the normal state no longer develop in these bones because they lack nourishment and space. To explain this it is necessary to admit what is shown elsewhere, that man descends from beings which were no more than tetradonts, i. e., after the nomenclature of the celebrated anatomist Owen, that they descend from beings who had only four incisors in their intermaxillary bones. Well, in the skulls at the Brussels University we have a hexaprotodont, we have six incisors in the maxillaries, two in each internal intermaxillary bone and one in each external intermaxillary bone.

Normal man possesses the two parasymphysians and the two pre-canines of these six incisors. The two second incisors, or pro-parasymphysians of the Brussels skulls, he no longer possesses. This incisor is then, according to my theory, an atavical tooth developed in these skulls by excess of nourishment and space which the two internal intermaxillary bones possess, following the double gnatho-uranoschisis. Thus, if in the hexaprotodont skulls at Brussels the parasymphysian is the first, the proparasymphysian the second, and the pre-canine the third incisor *in the normal skull, the parasymphysian has also the morphological value of the first and pre-canine, that of the third incisors.*

Thus between our first and our second upper incisors there is an incisor lost, the *true* second upper incisor.

Let us now look at our diagrams, see Figs. 10, 11, 12, 13, 14 and 15.

Fig. 10 represents the ancient theory of hare-lips: the "intermaxillary bone" bears these incisors; it is separated from the upper jaw by the maxillary cleft.

Fig. 11 represents my theory of double hare-lips with four incisors, theory published in 1878: the internal intermaxillary bone on each side bears the internal incisor, the external intermaxillary on each side, the external incisor. The maxillary cleft does not separate the upper jaw from the intermaxillary, but the external intermaxillary bone from the internal maxillary bone. On each side the co-existence of the maxillary cleft (endo-mesognathic) with the incisive suture (meso-exognathic) is seen.

Fig. 12 represents the explanation of Mr. Th. Kölliker of the double hare-lip: the cleft passes on each side between the internal incisor and the external incisor. According to his theory the cleft separates even in this case the "intermaxillary" from the upper jaw; only by "the independence of the formation of the teeth and of the formation of the bone" the external incisor is placed in the upper jaw.

Fig 13 represents my theory of the double hare-lip with six incisors. The internal intermaxillary bone on each side bears two incisors, the *parasymphysian* and the *proparasymphysian;* the external intermaxillary bone on each side bears one incisor, the pre-canine. The cleft is between the internal intermaxillary bone and the external intermaxillary bone.

Fig. 14 represents my theory of the dentition of our hexaprotodont ancestors who had the parasymphysian and the proparasymphysian in the internal intermaxillary bone and the pre-canine in the external intermaxillary bone. I have had a milk dentition drawn to facilitate the comparison with the other diagrams.

The last gives the morphological value of the upper teeth of the actual normal man who has lost the proparasymphysian and

who has only the parasymphysian left in this internal intermaxillary bone and the pre-canine in his external intermaxillary bone. After the loss of the true second incisor, or proparasymphysian, the pre-canine has become the pseudo second incisor in actual normal man.

What renders my theory of the morphological value of our second incisors still more likely is that almost the same processes have been proved in horses and rabbits; their upper anterior incisors are the first and the posterior the third, the second having been lost during the ontogenic development.

As to what concerns the horse with double hare-lip, we have seen that it is octoprotodont, while the normal horse is only hexaprotodont. What I have said referring to man can be applied *mutatis mutandis* to the horse. The horse descends from ancestors who had a larger number of upper teeth than it has. I recall here that there are still actually marsupials which are decaprotodonts (e. g., Piramels, Didelphys). In the double hare-lip of the horse the internal intermaxillaries each bear three incisors, while in the normal state they only develop two incisors. The external intermaxillary bone presents to us in these two cases one incisor —the pre-canine. It is thus evident that in the horse the excess of nourishment and space in which the internal intermaxillary bones rejoice in the double hare-lip has also favored the development of a supernumerary atavic incisor in these bones.

We can thus resume the cases of hyperodonty in the cases of hare-lips of horses and men in the following theory:

In the phylogenic development of mammals with two and more than two upper incisors on each side of the symphysis, incisors and pre-canines are constant, while the incisors situated between these two teeth no longer develop. In all these mammals the pre-canine is the incisor of the external intermaxillary bone, or the mesognathic incisor, while the incisors which disappear are all placed by the side of the parasymphysian in the internal intermaxillary bone, or the endognathion of mammals.

If one takes the hexaprotodont ancestors which are nearest man in point of departure, the pre-canine or the external incisor of actual normal man is certainly not the second, but the third, incisor. But if we now extend our theory to the pro-mammals, of which the number of upper incisors is not known, we can say that the external incisor or pre-canine of actual normal is the *n th* upper incisor of the pro-mammal, in designating the number of upper incisors in the intermaxillary bones on one side of the pro-mammal by *n*.

Resume.

I sum up the points briefly on which my paper has turned.

1. There are four intermaxillary bones, two internals, two externals.

2. The bud (*bourgeon* or Bürzel) in the double hare-lip is formed by the two internal intermaxillary bones.

3. The maxillary cleft in mammals is always situated between the internal intermaxillary bone and the external intermaxillary bone and not between the external intermaxillary bone and the upper jaw.

4. The co-existence of the maxillary cleft and the incisive suture on the same side is incontestably proven by a horse's skull and two skulls of men which have passed through my hands, and by the skull of a man described by J. F. Meckel. (Pathol. Anatomy, p. 540.)

5. When there are three incisors on one side, two of the incisors are placed in the internal intermaxillary bone, one in the external intermaxillary bone; the cleft passes in such a case always between the internal intermaxillary and the external intermaxillary.

6. The upper external incisor of normal man is in truth his third incisor, since a tooth which is situated between the upper internal incisor and the external upper incisor has disappeared during phylogenic development.

7. This true second incisor can make its reappearance in skulls by the maxillary cleft. In this case it is the most external of the two incisors lodged in the internal intermaxillary bone.

8. This atavic reappearance of a tooth which no longer develops in normal man finds its explanation in the excess of nourishment and space in which the internal intermaxillary bone rejoices on the side of the maxillary cleft.

It is very agreeable for me, in conclusion, to express my feeling of profound gratitude to Messrs. Dollo, Fleming, Héger, Houge, Jacques, Schwaller, and Thiry who have been so kind as to place at my disposal preparations which are in their hands, and to aid me in the publication of this paper.

The American Society of Orthodontists

Second Annual Meeting, held at Philadelphia, Pa., Oct. 8th, 9th and 10th, 1902.

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Second Annual Meeting of the American Society of Orthodontists.

President's Address.

By Edward H. Angle, M.D., D.D.S., St. Louis, Mo.

This morning we inaugurate what, let us hope and believe, is another important event in the evolution of the science of orthodontia, namely, the second annual meeting of the American Society of Orthodontists.

Objects of Organization.

You will remember that but one year ago, a little earlier than this, was held our first meeting. The organization of the society was fraught with much anxiety, much thought and carefulness of preparation. But its founders believed they were right and worked with an earnestness of purpose not often exceeded. They believed that in dental conventions, where papers and discussions on orthodontia were mixed with those on topics of general dentistry, the real significance and importance of this great subject was to a large degree lost; that such encouragement was not, and could not, there be given to fine and painstaking research in orthodontia as it demands in its present development; that the consideration given the subject under these conditions was usually superficial and not infrequently mere repetition from year to year of what could already be found in our literature. A few years ago such discussions were doubtless indulged in with profit, but the orthodontia of today requires most exact and painstaking research along lines remote from the mechanical phases (principally regulating appliances)

which were once thought to chiefly constitute the science, and demands the broadest study and a closer concentration of the best minds under the most favorable environments. Such environments can only be possible in a society devoted exclusively to its interests. Hence the organization of this society.

The number, character and scientific value of the papers brought before the first meeting awakened such favorable comment and such widespread interest as was most gratifying to its founders and strengthened them in their belief that the organization of the society was a wise procedure and that a great future was in store for it. And I feel confident, from my knowledge of the earnestness and ability of those who are to present papers here, and from the number and character of the men whose names have been presented for membership, that this meeting will also be in full keeping with the aims and objects of the society, namely, the furthering of the highest interests of orthodontia, in scientific research, in theory and in practice.

Orthodontia a Specialty.

I am thoroughly convinced in my own mind, and I believe it must be apparent to all thoughtful men who are at all familiar with the science, that the greatest future of orthodontia lies in its gradual separation from general lines of dentistry and its development as a separate and distinct specialty, and that both branches of practice would profit by the separation. When unhampered by the difficulties and annoyances of other phases of dentistry it becomes one of the most fascinating and lucrative branches of study and practice, opening up possibilities of results and attractive fields of research which can never be remotely possible to the general practitioner, interested as he is in the many other lines of dental science, each with its various exactions on his time and thought.

The successful practice of orthodontia by the general practitioner is now well-nigh impossible from the fact that the science now embraces so much and its progress has been so rapid in recent years that he cannot keep abreast of it and pursue a course of treatment which is up to date, in connection with the equally progressive and broadening branches of general dentistry, for he can at best undertake the treatment of but a very few cases of malocclusion in a year—never a sufficient number for him to learn much by experience. He must pursue the treatment of these cases, largely as experiments, possibly for many months, at such times as he can best spare between other operations which he usually regards as more lucrative or important. Thus the two classes of work necessarily conflict, orthodontia being the one most often slighted, receiving, in many cases, but a modicum of attention.

Should it occasion any wonder, then, that often long before these cases are completed they have become a source of much annoyance to him, often a nuisance and hindrance to his regular operations, and that he must lose interest and fall far short of accomplishing what would be within the easy possibilities had he an aptitude and liking for it and were he giving his entire time to the consideration of this special class of work, to say nothing of the increased ease and speed with which it might then be accomplished. Indeed his experience in orthodontia is necessarily so limited that he is very liable to commit such blunders in diagnosis and treatment that his results are more frequently harmful than beneficial to the dental apparatus as a whole. I have often been amused in dental society meetings or in reading the journals, by the discussion at great length of some supposedly rare case, offering many novel phases and difficulties of practice. In reality it is quickly recognized by the specialist in orthodontia as being one of a large number of similar cases—often quite a common type, which he could easily, speedily and successfully treat, for with him such cases have long passed the period of novelty and experimentation.

The Teaching of Orthodontia.

It is unfortunate that our colleges still insist on forcing every student to study orthodontia and on graduating him in it—a plan quite as absurd and as devoid of success as it would be to compel every individual to study and graduate in music or in rhetoric and oratory. Let us hope that the time is not far distant when the colleges will not only reform in their methods of teaching orthodontia, but will limit this teaching to the rare few in each class who have an aptitude and liking for the work, letting the remainder be spared the useless burden beyond instruction in a few general principles.

One of the most unfortunate results of the superficial way in which dentists have been taught orthodontia is that it leaves them in ignorance of how little they really know about it and how serious are the blunders which they commit. Let him who has not the time to study and practice it as it should be studied and practiced, desist; and let him who from ignorance or cupidity persists in mutilations so serious be legally restrained. We have stringent laws against the mutilation of man by his fellows. Why should they not be enforced?

Of course it would be folly to expect the immediate complete separation of two branches that have so long been blended in such supposed mutual interest, for great changes are usually effected slowly. While there are now but a few exclusive practitioners of orthodontia, yet I believe each year will rapidly add to this number, and I do not believe the time is far distant when each city of twenty thousand inhabitants

will be represented by at least one competent, conscientious specialist in orthodontia.

Let our efforts be to encourage all practitioners of orthodontia, but to offer greatest encouragement to those *young* men who wish to devote their lives to this great work, second in importance to none. Our services are needed by such vast numbers of humanity and our opportunities for good are so great by restoring normal relations and functions to the inclined planes of occlusion, enlarging the arches and vault of the arch and harmonizing it in its relations to the nasal tract, thus rendering greater beauties of the voice in speech and song, as well as adding to the beauty of the face, that who of us here can estimate the importance of our science or the great part which it is to play in the future?

Unsolved Problems in Orthodontia.

But let us keep in mind, notwithstanding the fact that orthodontia has recently made marvelous advancement, almost revolutionizing itself in the past two or three years, that there are yet many points on which much careful, painstaking and methodical investigation is needed. For example, from the behavior of the alveolar process, both in its absorption and reproduction, I am inclined to believe that we really know very little about its structure; that many of the accepted views of the older writers are very incorrect, and that, being more vitally interested in this structure than the practitioners of any other branch of medicine, from us must come the much-needed original work in regard to it.

And again, it has long been known that there exists a certain relationship between rhinology and orthodontia, but to what extent the two sciences blend or are interdependent is still undetermined. Both the orthodontist and the rhinologist have been working in almost total ignorance of the efforts and aims of each other, and in fields only separated by a single bony septum—the vault of the arch. To what extent is malocclusion due to pathological conditions of the nose and nasopharynx? And to what extent are these pathological conditions due to malocclusion of the teeth? The answers are as yet vague and indefinite, but their great importance must be apparent to all, and also the fact that careful, painstaking research, with many tabulated reports of results, are necessary before these questions can be definitely answered.

In my opinion we may have more hope from the investigations of the orthodontist than from those of the rhinologist, for it seems to me that of necessity the orthodontist is more vitally interested. The rhinologist may attribute his failures to causes over which he has no control and for which he could not be justly held accountable, so that partial success in his efforts might be acceptable; but with the orthodontist there

is no middle ground—no partial success. The teeth must be maintained in normal occlusion, or they will return to positions of malocclusion, nearly, if not quite, as bad as their original condition. In my opinion there is now no reason for the latter that is beyond the control of the orthodontist, unless it be pathological conditions of the nasal tract. And this leads me to believe that a very thorough study of the nasal tract is essential to the study of orthodontia, and that possibly the two classes of practice, rhinology and orthodontia, might with advantage be combined. Certainly an opportunity for much needed closer observation and investigation would thus be afforded.

Orthodontia and Physiognomy.

Another thought has impressed me strongly within the last two or three years—the importance of a closer study by the orthodontist of art in its relation to the face. That little or no attention is paid to it by those to whom the care of the teeth is intrusted is plainly evident in the impaired facial lines resulting from badly performed operations in orthodontia—chiefly those of the needless extraction of teeth for the supposed prevention or cure of malocclusion.

It must be remembered that each face is in reality a law unto itself, and a knowledge of the fine shadings of requirement necessary to bring out the pleasing possible harmony in the facial lines is difficult to master. Probably few will ever master it. The professional portrait painter can teach us much, but it will only be in a general way. He cannot know what is possible nor what is practicable with the orthodontist. We must study art broadly, and especially must our knowledge come up through the light of orthodontia as an entirety. Much good work is yet to be accomplished, and, let me repeat, it must come for the most part from the orthodontist. Each year I hope we shall have reports of good work in this interesting field.

Problems in Occlusion.

Again, there are several phases of occlusion about which we need to know more. One point over which many of us have doubtless been perplexed is that occasional case where, after placing all of the teeth of each arch in their correct mesio-distal relations, there is still an apparent disparity in the sizes of the arches. Is this true, and does nature really err in the proportionate sizes of the upper and lower arches? Or is it because the angles of inclination have been wrongly placed? Or is it due to what we might term "malocclusion from the improper adjustment of the heights of the molars?" Or is it due to a combination of these causes, in some instances and to unknown causes in yet others? I hope we shall have a paper at our next meeting dealing with this interesting phase of occlusion, and one, too, that shall settle

these points, for it would seem they should be within quite easy possibilities of determination.

I have shown in my last book that pronounced development in both alveolus and jaws follows correct adjustment in well defined cases of malocclusion. This fact means so much to both orthodontia and rhinology that we need to know to what extent these changes really take place; what ages and conditions most favor such changes. I hope all our members will have facts bearing on this point later.

Committee on Literature. I would also strongly recommend that a committee be created during this session whose duty it shall be to make careful report at each annual meeting of all literature and inventions of the year pertaining either directly or indirectly to orthodontia; also that this committee place upon exhibition each year all appliances, both ancient and modern, also anatomical, histological and pathological specimens, and anything pertaining to art that they may deem of interest to the society. I would suggest that this be a standing committee. The importance of this work in after years. if it be thorough, is not easy to estimate. It is well known that in orthodontia. as in other branches of dentistry, there has been in the past much carelessness in the matter of recorded dates of research and supposed inventions.

There are many more points of interest which I should like to set forth and elaborate upon, but there are so many papers to be brought before us that I will close, hoping and believing that in all our deliberations such kindness of toleration will be shown to individual opinion as becomes a true professional spirit and a desire for progress.

Discussion.

Dr. Joseph Head. I am very much obliged to you for calling on me, but I came into the society of orthodontists to learn and not to teach, for while I am very much interested in the subject and should be very sorry if I felt that I should not be able to give a certain amount of time to it, I think it is a subject that should be relegated to specialists; still there are some few minor troubles that we as general practitioners can successfully meet, as the field is so large and there is so much at stake. Too frequently we are tempted to extract teeth that ought to be kept, and too frequently we are tempted when we see a case that has been in the hands of a fellow practitioner, to feel that he has extracted teeth that we would not have extracted; and so it tends to make a general turmoil because the subject is not thoroughly understood, and where the evil is not thoroughly under-

stood it is a little bit difficult at times to be charitable, because charity, I think, is most apt to be where knowledge exists, and where knowledge is superficial we are apt to give superficial opinions and think we could do better in such a case, where perhaps if we had tried that same case we might feel that it presented difficulties that we might not have been able to meet. So with broad faith, generosity and professional spirit I most heartily commend everything that Dr. Angle has said as regards the necessity of making orthodontia a special branch of study in dentistry, and I hope that everything that can be done will be done to make this branch thoroughly successful so that it will be an absolutely correct science; so that every child who puts himself into the hands of the orthodontist may in due time have the features that Divine Providence intended him to have, rather than the features which the dentist thought Divine Providence intended him to have.

Dr. Barnes. I think the time is particularly suitable to take up this subject. There is but little knowledge as to what takes place in the alveolus, but now we have the X-ray, and I think we can learn a good deal if we use it a little more. That is, take the pictures before we start work and then during treatment, and in that way I think we would get some results that I do not know have been obtained so far. We can move teeth, but we cannot get hold of that cadaver well within the range of a good many years, and possibly not then, and we cannot know the final result.

Dr. Ashley Faught. I entered the room too late to hear the President's address, but I have heard enough of the discussion to understand that there was a recommendation to have this branch relegated to the hands of specialists. That is a proposal that meets my hearty approval. It is a subject I have dealt with from the student's and practitioner's standpoint for nearly twenty-seven years, and it is only during the last few years that I have realized the importance of the teaching upon this subject and for a more definite standard, especially for the younger men. I recognize the great importance of obtaining information, skill and knowledge in regulating and correcting irregularities of the teeth for one reason especially, that in everything we do we gather a certain amount of knowledge; it grows with us until we have professional skill, but all the time we are growing older and in no profession do we feel that growing older is a detriment so much as in the practice of dentistry. In law, medicine, theology, indeed in teaching even, we gather knowledge that becomes valuable, and the older we grow the more valuable we become to the community and to our science. That is not true of dentistry, for after we pass our fiftieth year and we begin to grow older, it is the younger men who

are sought, and the man with all the information and skill he has garnered for years, in the mind of the public, becomes a back number.

In orthodontia I recognize that the same conditions apply as to the physician; he gathers knowledge and becomes more and more valuable, and when he has reached fifty years he has something which will give him an income and growing practice in old age, a thing which is not true in the same sense in any other department of dentistry.

Dr. Monroe. Whenever I hear our worthy President say anything about orthodontia I feel almost ready to drop all general practice and go into this special branch of our profession. During the discussion of the President's paper I was impressed with the importance of occlusion and the recognition of these laws which originated in the minds of our President, and in the address he has given us he has laid out other lines of work that are sure to bring forth fruit that will be of equal importance to us.

The line of practice as a general practitioner is very different from that of those who give attention to these special branches, and while I, as a general practitioner, still hold on to my general practice, I am happy to say that I have gotten so far along as to give two days every week to orthodontia, and in that way I am approaching that point where specializing will be my forte.

It is a great pleasure to see what can be done along this line of dentistry. While I am not rapid in my work, the system which I have adopted in the correction of malocclusions has shown itself to be so superior to all other systems that it makes me feel more and more in love with orthodontia. The fact of having this law of occlusion set so plainly before us and then having a definite and fixed system by which we can correct these deformities makes it a great pleasure to work in this line.

I think the researches and plans of work which Dr. Angle has outlined will culminate in lasting and definite results.

Orthodontia from the Standpoint of the Student.

By Anna Hopkins, D.D.S., St. Louis, Mo.

The subject of my paper, as printed in the programme, is a misnomer. For me to undertake the discussion of orthodontia from the standpoint of the student, the *real* student, the searcher after orthodontic truths, would at least be very presumptuous. But orthodontia from the point of view of the undergraduate is a very different matter, and just at this time when so much is being written and discussed on this subject by the teacher and the practitioner, a word from the so-called dental student might not be inopportune.

Of course, earlier or later, most of us have been students in dental colleges and know from actual experience all the various sensations and emotions produced by its study (as taught), and its practice (as demonstrated), in our respective schools. Yet things not constantly brought before our minds are apt to fall off the hooks of memory, and teachers seem to forget that the precepts which now slip so glibly from their tongues, and the demonstrations that look so easy when performed by their deft fingers, were once as difficult for them as for the youths who now stumble through recitations on subjects which they often do not comprehend, and who awkwardly burn their fingers in trying to solder with precipitated chalk for a flux.

When a young man determines to enter the lists as a dental student his choice of a school, I think I may safely say, is in no case made with reference to whether orthodontia is or is not made a feature of this school, nor indeed as to whether it is taught there at all. It is, in fact, extremely doubtful whether he even knows the meaning of the word, and if he notices it in looking over the course of study in the college catalogue, he is glad to observe that that study, whatever it may be, does not come until the senior year. If he has ever heard of the "correction of irregular teeth" it was probably in the discussion by his family and the neighbors of some local case where months of the most intense agony was suffered during treatment, terminating in a case of nervous prostration or even typhoid fever, or at least where all the teeth "went back," or fell out, or decayed, or met with some other dire disaster as soon as the appliances were removed, the whole operation being scathingly denounced and the victim said to have been served exactly right for presuming to interfere with the plans of Providence.

He has troubles enough during his first year in school. What with

carving bone teeth, or modeling clay teeth, or turning out wooden teeth, products, not infrequently, that Nature in her most generous mood would never recognize as copied from her designs; taking modeling compound impressions and making models; shaping base plates; grinding and setting up teeth; packing, investing and vulcanizing and having the plate come out under-done or over-done or porous; casting dies and counter-dies; making all-metal plates; hours spent in the chemical laboratory making not-understandable tests for almost unheard of metals, and for compounds wholly unknown to him; hours in the histological laboratory spent in preparing and staining specimens, and in a mad and almost vain effort to learn the difference microscopically between tongue and fauces, spleen and kidney, lung and thyroid gland, striated and heart muscle, to be sure of red blood corpuscles and the structure of the liver; preparing for weekly or semi-weekly quizzes in general anatomy, and dental anatomy, and physiology, and osteology, and prosthetic dentistry; and last, but far from least, struggles over that horror of horrors to the Freshman student—dissection, the young man finds no time nor takes any interest in the murmurings or mutterings or mutinies of upper class men over any of their trials and tribulations, and certainly not over anything so vague and inconsequential as this orthodontia, *unless* he happens to have unusually marked and noticeable malocclusion, when he is likely to be inveigled by some ambitious senior into having appliances put on his teeth—usually to the present sorrow and discomfiture of both.

His second year is just as crowded with work as was his first, but in most schools even the junior student sees and hears practically nothing of orthodontia, or, in the event of his being required to make "regulating appliances" this year, or, more rarely, to take the lectures in this branch, he has no interest in the work for already he has learned the status of orthodontia in the school; already he knows how lightly it is regarded—how unimportant it is thought to be, and feels that time spent in even listening to the lectures is time wasted. This time spent in putting in gold fillings he thinks would be infinitely more to the purpose and in keeping with what he is there for. During this year he "finishes" the greater part of his theoretical work, learns various methods of making crowns and bridges, often spends much time in learning, or attempting to learn, to make various alloys and amalgams, and in testing the latter for edge strength, flow, shrinkage, expansion, etc., learns to prepare cavities for filling, and in many schools devotes at least the latter half of the term to actual clinical work.

It is with a feeling of considerable satisfaction in having overcome many obstacles that he enters upon his third year's work. He thinks he knows a great deal about dentistry now, and with the experience of the

coming year feels that he certainly ought to be competent to undertake almost anything in a dental way. While he is presently to discover that really he has many more things to learn than he probably now knows, it is no doubt true that up to this point he has had good and practical teaching; that all has been done for him that teachers can do under the conditions existing in our dental colleges today; that he has been started in the right direction and that his further development must come through his own efforts, his own mistakes and successes, his own experiences. His teaching in what we may term "general dentistry" began two years prior to this and has advanced logically, step by step, to this point. Prosthetic dentistry was not taken up and finished the first year, crowded in with anatomy and physiology, chemical and histological laboratory work, etc. Operative dentistry (together with the manufacture of the tools and instruments necessary to its performance), was not taken up and disposed of the second year. No. They were taken up logically and proceeded by a natural evolutionary process to this the third year where they are blended into a practice as nearly like an actual office practice as it is possible to bring about.

But we pause on the threshold of the third year to find that with very few exceptions not one word has as yet been taught on the subject of orthodontia, a branch of dentistry that has proven itself to be at least as great as either prosthetic or operative dentistry from the fact that those few men who, finding their combined practice uncongenial, impractical and undesirable, have abandoned the successful practice of general dentistry to take up orthodontia as a specialty and have made of it their greatest success.

Here is our student who this year is to perfect himself in the practical work of preparing and filling all sorts of cavities with the various golds, amalgams and cements; of diagnosing and treating an almost endless variety of pathological conditions of the oral cavity, including dying, dead and putrescent pulps, abscesses both chronic and acute, pyorrhea alveolaris, tumors, etc., etc.; of extracting teeth; of making and fitting partial and complete artificial dentures; of making and setting plain gold crowns, and Logan crowns, and banded Logan crowns, and Richmond crowns, and all-porcelain crowns, etc., with the same or greater variety of bridges—certainly a most stupendous undertaking—and yet in addition to all this he is expected to complete *this year* not only the theory and practice of orthodontia, but in nearly all schools, to manufacture the very appliances he must use in the treatment of his cases. And when we consider that at this time he probably cannot even give the normal occlusion of the teeth, which is to orthodontia what the alphabet is to literature, we can form some conception of what an impossible task

confronts him. No faculty would expect even the most exceptional student to learn in a single school year all that he should know in order to begin the practice of operative and prosthetic dentistry, and yet it is not the exception for them to expect all, even their most inferior students, to perfect their knowledge of all other branches of dentistry, and in addition to learn all of orthodontia in nine months, or oftener less.

Importance of Knowledge of Occlusion.

If the student had been taught when he was studying dental anatomy in his freshman year that occlusion—*normal occlusion*—was the basis, the very foundation stone, of not only orthodontia, but *of all dentistry,* he would, if he must wait until his senior year for the remainder of his orthodontia work, have at least laid the correct foundation for the structure he must build. If he had been taught in the beginning that the normal occlusion of the teeth was the underlying principle of every operation he would ever perform in dentistry, he could not have failed, be he never so dull, to have seen the application of this beautiful truth all through his practical work, and as his mind developed and gained a firmer grasp on the subject from Nature's point of view—the jaws and teeth as a perfect whole—he would have seen the beauties of occlusion in all the minute details of his work, in his treatments for preserving the teeth, his fillings for restoring their perfect contour and incising or masticating surfaces, and in his crowns and bridges for preserving space and restoring occlusion after extraction of teeth, and dentistry must then inevitably have at least a more scientific meaning to him than it could possibly have without this knowledge. Then in the mouths in which he performed these operations any teeth in malocclusion would not only be apparent to him, but he could not fail to recognize the importance of having them placed in normal occlusion, although he might not yet know how to do this. But he would, perhaps unconsciously, be studying orthodontia all the time.

But he is not taught the normal occlusion of the teeth in his freshman year, nor in his junior year, nor even in his senior year (except, possibly, in excedingly rare cases). So when he undertakes the treatment of a case of malocclusion he does not know what the trouble is, nor how it is to be overcome, nor with what end in view. He only knows that the teeth are crooked and that some form of regulating appliance must be adjusted to move them into an arched form. He has only a vague idea of what appliance to use, of how to adjust it, and of how to operate it after it is adjusted. But he does know, after a short time, that it makes his patient's teeth very sore and that the patient is very nervous and irritable; that he has great difficulty in keeping the appliances in place; that at almost every visit of the patient some portion of it is either loose

or out of the mouth entirely; that it usually does not move the teeth he wishes to move and that it does move the teeth he does not wish to move, and that when he discovers this he has no idea of how to overcome or correct it; that the patient always comes when he is all tired out or very busy at other work and cannot be coaxed, threatened nor bribed to keep regular appointments; and that he receives practically no encouragement, but only discouragements all the way through, with rarely even success at last to crown his really honest efforts. When he discusses the subject with his classmates he finds that their experiences are very similar to his own. He is thoroughly disgusted with orthodontia and vows that it is one kind of dentistry with which he will have absolutely nothing to do when he gets out into practice. He denounces it as a fraud, a snare, delusion, stumbling-block, and gives small credit to the reports he hears and reads, of successfully treated cases.

The really sad thing about it all is that he takes these impressions with him when he goes out to his practice, and every student who goes out with this feeling towards orthodontia, and there are few who do not, is another clog to the wheels of progress of this great science.

But the trouble does not lie with the student. He went to college to learn dentistry and at his graduation he is to some degree excusable if he thinks he knows the greater part of all that is worth knowing of the subject. The great central truth—occlusion a knowledge of which would illumine the whole path of orthodontia and ignorance of which leaves it "without form and void" is still there, as it has always been, like the law of gravitation, but if the student is not taught it and to see its application he cannot be blamed for not knowing it. That he can and does learn to do other dental operations without knowing occlusion he has demonstrated; that he can do them better, knowing occlusion, he will doubtless yet demonstrate; but that he cannot learn orthodontia without knowing occlusion is indisputable, for without it there can be no true orthodontia.

Faults in Teaching of Orthodontia.

We have endeavored to show what an exceedingly busy life the dental student leads and how full must be his every moment if he would get only what is barely necessary out of his brief college course. We have further endeavored to show how very busy he would still be were no work in orthodontia whatsoever required of him. All the work is so hurriedly crowded and jammed into three short years that that thoroughness in every detail, so essential to nice and accurate work is simply out of the question. This is true of all the branches taught, but that some are more neglected than others is also true, and that orthodontia is the one most universally neglected is undeniable. No other branch is

left to be studied as best it may at the last minute. For other branches of work the very finest instruments, carefully selected, are thought none too good, and with these students are required to provide themselves. No student would use and no teacher would expect him to use chisels, excavators, pluggers or other instruments of his own manufacture, and yet those regulating appliances that he himself makes are generally the only ones he has to use in his orthodontia work. For the work of all other branches of dentistry conveniences such as rooms, chairs, cabinets, fountain cuspidors, blow-pipes, vulcanizers, soldering and work benches, mallets, forceps, etc., are provided by the college, but there is no provision made for the orthodontia work either in the clinic or in the laboratory. Indeed in attempting to do any work in orthodontia in a dental college it has sometimes seemed as though every possible hindrance was thrown in the way of the student and that help of any sort was denied.

Is it with this in mind that the National Association of Dental Faculties has added another year to the prescribed course of dental study? Has it at last awakened to a realization that heretofore orthodontia has not been justly dealt with, and are preparations now being made to give it at least an equal chance with other dental branches by providing for it more time?

At all events, if orthodontia is ever to be lifted to a higher plane, if the truth concerning it is ever to be generally known, there must be made some radical changes in its teaching.

First, as has already been said, the principles of occlusion and their application must be taught and taught early in the course. There must be provided a place in which to teach and demonstrate orthodontia technique, *including* the proper taking of impressions and making of models. To see a student endeavoring to carry on a course of treatment with no models of the original condition of his case is a pitiable sight. This laboratory should be separate from the others because it requires entirely different fittings and furnishings. The tools and instruments of the orthodontia laboratory would be not only useless but in the way in the general laboratory, and *vice versa*. This part of the course might well be conducted during the second year. Next very properly might come the work of classifying cases from models provided for the purpose by the college, and a little later the study and diagnosis of actual clinical cases, impressions, of course, being taken and models made of each case, and the study of the case not limited merely to the irregular teeth, but extended to include, first, the relations and extent of the maldevelopment of the jaws; second, the condition of the nose, nasal passages and throat as to whether it be physiological or pathological; and third, the extent of the abnormal development of the face as dependent upon the malposed

teeth. And being thus thoroughly rooted and grounded in the subject he can begin the treatment of practical cases in his fourth year with some hope of success. When cases are presented for treatment he will realize what is wrong, know what is necessary to be done and how to do it, at least theoretically. He will have sufficient time so that one or two afternoons of each week can be given over entirely to the treatment of his orthodontia cases and he will not have to contend with the confusion and discouragement incident to attempting to combine the two classes of work.

Such a course of study for orthodontia, or one something similar, would at least give it its dues, and students an opportunity to learn it at least as well as the other dental subjects. If, after some experimenting, it were found that only a comparatively small number of students had any especial interest in the work, that to the majority it was irksome, arduous and not to their liking, the last year, the year of treatment, might be made optional, those desiring to perfect themselves in the work being given special privileges, and those to whom it did not appeal excused from the work altogether.

It is a rule, almost without exception, I believe, that in any class who study orthodontia those members who are at all interested and who can show any kind of successful results are among the very best students in the class and very few in number. This fact, together with the almost infinitesimal percentage of orthodontia specialists in the dental profession leads to the belief that it may never, no matter how carefully and thoroughly taught, appeal as a branch of practice to the mass of dentists. And herein unquestionably lies the greatest chance for a bright future for orthodontia. As one part of general practice, either individual or composite, it could only be advanced in proportionate ratio to the advancement of the whole, but separated from general dentistry, detached from it, it becomes the all-excluding center for concentration of thought and work, and may grow, expand, unfold in every direction, unhampered, untrammeled, unencumbered by that mass of other work which can never lift it up, but can only keep it down, and of which it is at best only a distant relation.

Discussion.

Dr. Brady. Being a teacher of orthodontia I am unusually interested in this extremely valuable paper. I appreciate the principles set down by the writer and I agree with her to the fullest extent. During the years of my struggles to teach orthodontia properly, I have met with every difficulty described by the writer in presenting this matter properly to the student. I have

met with the difficulty of improper rooms; insufficient time; and lack of facilities of every sort. Most of all, the indifference of the students, which comes only from very great ignorance of the subject. I have struggled along the best I could, hoping today to do better next year, and have naturally been led into examining the methods of teaching orthodontia in other schools. I find that they have all suffered the same difficulties, except that they are greater in number and worse in condition. I am not surprised that the ordinary practitioner feels that orthodontia is a nuisance and a burden upon him. If he were to receive no better instruction in crown and bridge work than he does in orthodontia, no more time devoted to it nor better facilities provided for it, he would consider crown and bridge work as big a fraud as he does orthodontia; and if he had no better instruction in filling teeth he would be no better a practitioner of operative dentistry than of orthodontia. I feel that aside from the lack of time, the lack of apparatus and the insufficiency of teaching that is given in orthodontia, one of the greatest drawbacks toward its success, both in teaching and in practice, is the fact that the student is taught to dabble with regulating appliances. There is no more excuse or reason for a dentist to make his regulating appliances than to make his entire outfit of instruments. Regulating appliances are merely the instruments with which he carries on his work, they are not the end of his work, they are mere sideshows to something which is infinitely greater.

I consider the paper very good in every detail. The question of how and what it will ultimately grow to is one which we could most profitably discuss. Whether the addition of one year more to the college curriculum, and the additional attention orthodontia will then receive, will do anything, remains to be seen. I think it should be taught as a specialty. When that time will come remains to be seen. I am very glad to express my hearty concurrence with the sentiments of the paper.

Dr. Kirk. I thank you very much for the invitation to speak on this question. Unfortunately I did not hear all of the paper. I came in late and only heard the closing portion of it. I hope it may not seem presumptuous to speak on this question before a body of specialists in this important department of our work. But I am glad to say something from the point of view of the teacher, because I do happen to have some relation to the general subject of dental education, and I must say very emphatically that I cannot agree with the position of the essayist with reference to the condition of orthodontia teaching, at least in so far as my experience as a teacher is related to that subject.

I quite agree with her, as we all must agree, that the wonderful impetus which has been given to this branch of dental science by the

recognition of the importance of occlusion as a central fact from which all these variations start, as given by our distinguished president has given a new life to the subject and systematized it, and it is a magnificent example of the potentiality of a principle which once enunciated, goes on and carries out its perfect work until it is completed. We knew nothing of orthodontia as a science until Dr. Angle presented this principle to us clearly and definitely.

The essayist will pardon me—I don't know her personally nor in what relation of life she exists, but it seems to me that it is one of two things, that she has either been acquainted with a school that is careless in this matter or has based her statements upon observations made a number of years back before this principle began to have its effect upon dental teaching.

I want to say that in the school with which I happen to be connected, and also in others that I have examined, and I hope that this society does not claim that the question of occlusion is restricted in its application merely to the question of orthodontia, that it is taught that the principle of occlusion is at the very foundation of dental practice. We teach the principle of occlusion at the very beginning of the dental course, as the foundation of prosthetic work, of operative treatment, and we consider a man is not fit to go ahead with his practical dental work until he is well grounded in a knowledge of the individual teeth, their forms and the relationship of the several forms as manifested by complete normal occlusion. They must know that before they are fit to go ahead with their operative work or any other branch of dentistry. So occlusion forms the foundation of our teaching in the first year. I do not claim that we are offering a perfect system of technical education in occlusion, but I do claim that we recognize the importance of the principle and are endeavoring to enforce that principle as the basis of our technical course.

There is another feature with which I want to agree in what has been set forth in the paper, that the specialist in orthodontia will be the outgrowth of natural selection, so to speak. In teaching it becomes evident very soon that certain men will, by reason of their natural tendencies and tastes, elect certain departments in which they will specialize, and it becomes the part of the teacher to furnish opportunities for the development of these men in specialties.

I agree with the paper as to the fourth year. I stated at the meeting of the Dental Pedagogic Association at Pittsburg, that I felt that the early part of the course should be based upon the idea of furnishing instruction in all of the foundation principles of dentistry, and that the fourth year should be given largely to elective groups, in which ortho-

dontia in its practical application will take a very important place; there should be an opportunity given to develop specialists, but we should not require the average student to take the fine details in orthodontia which we would require of the specialist.

I trust that the dental profession at large understands that the dental institutions can only go so far. There is significance in the name which we give to the termination of the course in dental instruction—Commencement Day. It is literally commencement day. The most that any dental institution can give to any man is to direct him in the road of study, to give him a point of view, so that thereafter he can go on with his real education. That, to my mind, is as much as any institution can do, set him right on his professional pathway, giving the fourth year to specialties and in the three preceding years laying the foundations of all that relates to the practice of the science in which we are interested.

Dr. Grevers. Here I think is a subject for extension of learning. The position I fill in the University at Amsterdam is a broad one and I have to go over every branch; so I give the students an idea of what is normal and abnormal occlusion. You cannot expect students to be proficent in every branch They should be instructed in the general principles and then leave what they want to acquire especially to special schools.

Dr. Lourie. I would be glad to add to the paper if I could, but on the whole the essayist has stated the case about as I see it. As I understand the essayist's intention, it is to intimate that the dental schools do not as a rule give enough attention to the subject, and that the information given by them is not as it should be at present, and instead of giving so much detail in the matter of constructing appliances, the schools should give more of the fundamentals of dental study—of occlusion and the requirements of occlusion in association with the facial lines and development of the face, etc.—so that on the whole I can have nothing to say in the discussion of the paper other than approval, with the exception that the essavist may have been a little too emphatic in the denunciation of the course as at present given, but it may be that she has given the conditions found in some of the colleges that are less careful in the course of instruction. Otherwise I would heartily approve the sentiments expressed.

Dr. Casto. I desire to commend Dr. Hopkins on this paper. In my experience and observation not only with colleges but with dentists and with students, it has invariably been the same; they do not understand occlusion. It was not taught and is not taught properly in most of the colleges. I believe there

are some in which occlusion is properly taught. A great many men are being graduated each year who do not understand occlusion. We might just as well take the medical student and give him a few lessons in anatomy and send him out as a physician. The surgeon who does not understand anatomy is just as poorly equipped as the dentist who does not understand occlusion. Something will have to be done whereby this branch of dentistry will be more thoroughly taught.

I do not think the essayist meant we all should be specialists. I agree with Dr. Kirk as to making the fourth year elective. We want to teach the students enough orthodontia so that when they go out to practice they will appreciate what this branch of dentistry is. If the student in medicine knows enough, when graduated, about rhinology and ophthalmology to know that he cannot practice them in connection with his general medicine, he knows that he will not practice them at all, and that is what we want of the dental student in regard to orthodontia.

I don't know whether Dr. Brady referred to the school in which I teach, but I blush in the dark when I think of the things I told last year. These crude methods are still being taught in some of the institutions. Why is it that the student gets lost and feels that he does not understand orthodontia? It has been very well outlined in the paper. It may not be true of some colleges; I will make an exception of Dr. Kirk's college.

Dr. Kirk. With reference to the fourth year, I did not mean to convey the idea that orthodontia should be excluded from the preceding three years at all, but that the fourth year should be devoted to specializing this work.

Dr. Angle. I cannot let this opportunity pass without saying a few words on this very important subject. I was a teacher some fourteen years at dental colleges. During that time I was connected with four different schools. I came in contact with a very large number of students and I tried just as hard as I could in every way to interest them, freshmen, juniors and seniors. I would talk orthodontia to them, always trying to get enthusiasm; trying to get the management of the schools interested so that they would give orthodontia something like a fair show which I always felt it ought to have; but I believe that most of those long years of very arduous work were largely a failure. The boys would be very enthusiastic at first, all would be specialists the first week; the second week but a few would be specialists, and the third week you would see their coat tails going around the corner when orthodontia was mentioned. I did not blame the boys very much for that; there were many conditions that led

up to that. They did not know the importance of it and their minds were not developed to an appreciation of its great possibilities for good. They had so many other things that the time was crowded out, and worst of all, they never had any conveniences. If the schools grew, and they usually did, the room we had appropriated one year was taken up the next by the extra number of chairs, etc., and orthodontia was always being crowded more and more to the rear. I saw I could only teach them a mere smattering and could never carry them along far enough so that they would be sufficiently interested to go on by themselves. They got a smattering of it and went out with that sort of hidden understanding that they knew it all. Any one who has ever examined students in orthodontia knows very well that there is only a small percentage of them who would amount to anything if you taught them thirty years. They are not artists; have not that innate judgment and ability to cope with the changes that come about with each case daily. The conditions are changing daily, temperaments, and types and pathological conditions all modify this so that there are a very few who will make a success of it.

I have studied boys carefully and think it is the height of absurdity and almost criminal to compel boys who have no liking or ability for it, to go blundering on and pass an examination in it and then turn them out, blushing to acknowledge that they do not know all about it. You see the results of what they are doing all over the country.

Dr. Watsing. I think Dr. Kirk misunderstood the sentiments of the paper. The author did not mean to convey the impression that there were no schools teaching occlusion, but she did say there are very few, and I would like to emphasize it; there are exceedingly few.

Some exception has been taken to the mechanical phase of it. I have had some little experience in consultation work, and men have come to me who have been taught by some of the most eminent instructors, men who could do most beautiful mechanical work, and yet they have brought models and told me they had been working on cases a year and a half and two years without succeeding in producing widening of the arch or the rotation of a tooth.

If the time spent in hammering out different appliances and trying them, making nuts and screws and so on, while in college, had been spent in the study of occlusion alone they would be better orthodontists. They thought it required a distinct appliance for each tooth, and in making one or more movements, they had to have a different appliance for each direction. There is no need of a great massive volume of pages and distinct appliances; they could be described in a very small pocket edition.

With regard to Dr. Grevers's statement that we are overcrowding the students, I believe that. I believe in the high schools, in the grammar schools the students are being overcrowded, but my experience with dental students is that there is very little danger of overworking them, but to provide for that emergency, with a fourth year added, let us hope that just a little of that time will be devoted to teaching orthodontia, and teaching real orthodontia and not how to run machine shops. Dr. Grevers said it was impossible to teach all the various branches of dentistry. I agree with him, but would Dr. Grevers in his school graduate a man who intended to practice merely operative dentistry and not teach him prosthetic dentistry? I think not. We must not graduate men who do not have some knowledge of orthodontia, although they will not all be orthodontists. I hope not, but I do think it is necessary that the student should be taught the true principles of orthodontia and that they should have some little clinical experience, for the reason that the people who are so fortunate as to live in our large cities are able to secure the services of specialists; but think of the thousands of people located in small towns who will not and cannot support an orthodontist. Must they go without such services? If they cannot have the best, give them the best they can get. It is the same in medicine, if the general practitioner of medicine knew nothing in the way of surgery we would have to turn the world into a cemetery. We should teach men the vital principles of orthodontia. Most of them would be able to do something, and could refer their more difficult cases to specialists. I plead earnestly for the teaching of true orthodontia, to a degree that will enable the student to give good advice if they do nothing more and that they are not doing now. The advice of the average general practitioner is awful; ninety-nine times out of a hundred I believe radically wrong. Why? Because he does not know anything about it and he knows not that he does not know.

Dr. Grevers. I do not think that I made myself clear. I meant to convey the idea that the student should be taught every branch each by its own professor. If there were five or six examiners and every examiner wanted the student to be excellent in his department, no student would pass the examination; so I mean to say they should have special teaching in every branch. They should have the elements, but they cannot be taught everything; it would take a lifetime and he would be old and gray-haired if he understood every part of dentistry to perfection. I have been for twenty years one of the Board of Examiners in Holland and I have often noticed if a student was excellent in diagnosis he was a poor operator, and *vice versa,*

a good operator was a very bad diagnostician. I think in a college of four hundred students only three or four would be excellent orthodontists. This must all be taken into account in teaching students. We must not expect of a young man that he be proficient in everything.

Nasal Occlusion and Septal Deviation in Their Relation to Antral Development and Facial Expression.

By Royal S. Copeland, A.M., M.D., Ann Arbor, Mich.

In preparing this paper your writer has taken it for granted that any material bearing upon orthodontia or heterodontia* will be of interest to your society. The blanket title assigned by your secretary is almost as comprehensive as the blanket charters granted under the laws of certain States, by the terms of which a corporation may engage in anything from silver mining to ping-pong. The truth is, there is so much to talk about in this connection that it is embarrassing to feel the restraint of a set subject. I do want to remark, however, that you orthodontists have a most attractive field of labor and in your specialty are performing wonderful feats.

Orthodontia and Rhinology.

It is difficult for one whose thoughts are usually turned in other directions and who has personal acquaintance with very few of your profession, it is difficult, I say, to know how fully you appreciate the relation between your specialty and that of the rhinologist and laryngologist. This intimate relationship and the interdependence of the specialties are the two things which make me tug at the halter of a fixed title. This intimacy is not alone a matter of neighborhood relation, but dates back to a common embryological development. It will be remembered that the naso-frontal process, which enters into the formation of the intermaxillary portion of the upper jaw, also has an important part in the formation of the septum and bridge of the nose. The palatine plates, too, in that they form the roof of the mouth and the floor of the nasal fossæ, are common to your specialty and mine. Furthermore, certain morbid conditions of the nose and throat produce evil results in dental development and some forms of heterodontia are responsible for deviations from the normal in the organs looked after by the rhinologist and laryngologist.

*Mal-position of teeth. Word coined by the author.—Ed.

Etiology of Malformation.

One cannot make a critical study of deviation of the nasal septum and malocclusion of the teeth without being struck by the remarkable parallelism of the two conditions. Both appear at the same age, they are frequently found in the same patient and, in my opinion, have much in common etiologically.

Placing all the deformities of the nose and mouth into one class and considering them as different expressions of a single condition, it is interesting to theorize a bit as to the causative factors responsible for these unsightly deviations from the normal facial lines. Every such case, of course, arises from causes congenital or acquired. Of all the cases, those due directly to congenital causes are the least common. But, to make a proper classification, it is necessary to include in the congenital forms certain cases which are due to nasal or postnasal diseases, themselves the natural result of congenital causes. In this, I refer particularly to such cases of septal deviation or malocclusion of the teeth as accompany adenoids or tonsillar hypertrophy. This question will be dealt with more at length in another place.

Embryological Origin of Facial Deformities.

The embryological origin of many of these deformities has been overlooked by most writers. The reason for this is quite apparent. Most congenital defects of the head, for instance coloboma of the iris, hare-lip and cleft palate, are expressions of arrested development which are apparent at birth. Other abnormalities recognized as congenital in origin appear very soon after birth. Septal deviation and the various deformities grouped under the general term of heterodontia, in most instances, do not become apparent until the seventh or eighth year. Naturally, therefore, the possibility of congenital origin is overlooked and a less remote cause is sought.

Unfortunately, I have not at my command all the literature bearing on this question. Danziger, a Continental author of importance, has written exhaustively concerning the nalformations of the palate and their relations to the nose, eye and ear. The *Monatsschrift für Ohrenheilkunde*, No. 1, 1900, has an abstract of this article and it advances a reasonable theory for many abnormalities of the nasal, superior and inferior maxillary bones.

Some Embryological Facts.

Before considering this theory it is well to recall some embryological facts. Embryology, as you know, is a science which is yet in the stage of development. Fortunately for us the parts of the head in which we are interested at this moment are among the settled portions of the science. Perhaps these problems are not so thoroughly solved as

to be numbered among the "Eternal verities," but for all practical purposes they are settled.

I agree with my friend, E. D. Reed, who includes in the science of embryology, not only the changes which are completed in utero, but also the processes which begin at that time, even though they are continued through infancy to early adult life. The foundation of Danziger's theory is one of the processes normally incomplete at birth, but associated with changes strictly embryonic.

It will be recalled that at the base of the skull the embryonic head has several, eight to be exact, separate and distinct bones. These fuse during early life and the total number is divided by two. The thing of special interest to us is the fusing of the baso-occipital and the sphenoid. Normally this takes place in early adult life, actually it undoubtedly occurs much earlier in many people.

Congenital Malformation.

Too early fusion at this point impairs the growth and development of the base of the skull. It shortens the space between the foramen magnum and the base of the nose, at the same time impeding the growth of the maxillary bone. Danziger contends that in consequence of these phenomena the palate is pressed upon from all sides with the result of a high, pointed palatine vault. This in turn encroaches upon and narrows the nose and nasal pharynx.

Granted that this is true, and it looks reasonable, the deflected nasal septum is the result of causes which may be traced directly to an embryological source. The shortening of the baso-cranium may be a cause, too, for a deficiency in the growth of the orbit with consequent involvement of the eye. It throws light on the deafness in deaf mutes. A disturbance of the aural cavity with an interference in the growth of the tympanum causes such impairment in shape and function as is found in deaf-mutism.

Danziger's theory is attractive and it appeals to me as worthy of tentative acceptance. It explains why a face, which in infancy and early childhood is symmetrical and attractive, becomes massive in its upper half, and diminutive in its lower half where its growth is impaired by accident of development. It does not explain all of the cases of septal deviation or dental malposition. It does not account for the majority of them perhaps, but it does explain the cases of heterodontia occurring in children free from nasal and throat diseases, children who have been well and healthy from the time of birth.

Acquired Malformation.

There are cases of malocclusion and septal deviation which cannot be explained on this hypothesis and yet, as I have said, they might with

all propriety be classified as congenital. I refer to the deformities resulting from nasal, postnasal or pharyngeal disease which in itself is congenital in origin. The immediate cause, however, for the facial deformity in such patients is exactly the same as would produce such a deformity after traumatism or acute disease. To be more explicit, it makes no difference whether the nasal occlusion, for instance, be due to adenoids or to cicatricial contraction following a burn. Therefore, I will consider the remaining possible etiological factors in facial deformity under the head of acquired causes.

Mouth-Breathing. No matter what may produce the nasal occlusion, it is the mouth-breathing, chiefly, which has to do with the change in the facial expression. Reference to your authors shows this to be a threadbare subject. You have already discussed, pro and con, the action of the buccinator. In passing, you will permit me to say I have fancied the human anatomy has been somewhat amplified and embellished by a few of your writers in an attempt, apparently, to force a conclusion not altogether justified by the ordinary dissections. But it is undoubtedly true that the hanging lower jaw, and the action of the facial muscles upon the plastic alveolar process has much to do with the development of the heterodontia.

Psychic Phenomena. Many children have habitual facial expression as a physical manifestation of certain psychical influences. It has been noticed for years that diseases attacking certain regions of the body manifest themselves by certain lines or furrows in the face. In abdominal disease, as for instance gastro enteritis or even chronic gastric irritation, there is found a distinct furrow beginning at the ala of the nose, passing downward and curling around the corner of the mouth. In disease of the lungs or air passages there is a line from the angle of the mouth, running outward to be lost in the lower part of the face.* These lines are the result of unusual muscular force habitually acting in one direction. The symptom of pain felt by the little patient is manifested in this way. It is conceivable that mental conditions from other causes may result in fixed expressions. The distribution of force by the action of the muscles in the happy, changing moods of the child and the placid expression in sleep are lost. The unequal distribution of muscular effort probably has its effect upon the alveolar process. Therefore, psychical influences must be counted as one of the possible factors in the production of heterodontia.

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*Eustace Smith, Disease in Children.

Septal Deviation Not Due to Acquired Causes.

It is important to know whether or not the bone itself is influenced by the movement of the teeth. If it is, Dawbarn's theory* is worthy of consideration. He says the pull on the adherent faucial pillars, in enlarged tonsils for instance, influences the dental arch, while the disuse of the nasal passages in mouth-breathing produces negative presure there. Acting together these forces would cause the vault of the mouth to rise and tend to point the dental arch. Septal deviation and malocclusion would result.

The fact is, however, that careful measurements of Dr. M. T. Watson's models show that in the reverse process, i. e., in the correction of the deformity, the roof of the mouth is unchanged in position. These models, showing as they do most wonderful changes in the breadth of the dental arch, reveal no change in the height of the vault. In the light of my present experience and observation I believe that wonderful, plastic, supporting tissue, the alveolar process, is alone affected by the pressure, be it accidental from muscular action or intentional from the appliances of your specialty. Septal deviation, then, is not to be expected as a result of malocclusion from most acquired causes.

Other Causes.

Did time permit it would be interesting to consider the possible relation of failure of local nutrition to the malformations under discussion. Some other writer may touch upon the differences, in structure, origin and development, between the maxillary bone, cartilaginous originally, but ossified in embryo, and the alveolar process, membranous, really sesamoid in nature, not permanent, serving its day and generation and disappearing. The influences of some underlying dyscrasia or diathesis is another point worthy of thought. I am content, however, to leave the subject here and let another finish the incompleted work.

The Maxillary Sinus.

There is one other topic to which attention should be directed for a moment or two. The title assigned me gives license to consider at some length the relation of the antrum to facial expression. The development and growth of that sinus, however, has so little to do with the change in facial lines, that trespass upon your time for that discussion would be unwarranted. The popular idea is so counter to this statement that it may be wise to say a word or two in defense of the proposition.

Between the middle and inferior ridges, which later become the turbinated bodies, about the tenth week of embryonic life there occurs an evagination of the ectoderm into the maxillary process. The result is

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the formation of the maxillary sinus. This change is a peculiar one. It is an actual hollowing out and destruction by ectodermic tissue of an otherwise solid bone. We can think of it as a sort of normal or physiological malignancy. The process is not complete until early adult life, but the peculiar way in which the antrum develops explains why there is no change in the external face. It is not a swelling or inflation of the maxillary bone, but a resorption of its interior. Under normal conditions, then, we need expect no change in the facial lines by reason of antral development.

Relation of the Antrum to Malformations.

Unfortunately, the maxillary sinus is not always normal in development or condition. In fact it is more commonly diseased than the most careful writers of a few years ago supposed. Your own Professor Cryer and doubtless others of your profession have called special attention to the importance of observing the state of the nasal accessory sinuses. It has remained for Grünwald, Herbert Tilley and one or two other investigators to determine the far-reaching evils attending nasal sinusitis.

In chronic empyema of the antrum that sinus becomes a reservoir of pus which overflows into the nose, passes into the throat and is swallowed. Septic conditions affecting the entire system are sure to follow. This result is to be expected, but there is another effect of sinus involvement which until lately has been almost entirely overlooked. I refer to nasal polypi. Where they exist, in practically every case the primary disease is located in one or more of the sinuses.

In summing up the relation of antral involvement to heterodontia, let me call your attention to a kind of "house that Jack built" sequence: Diseases of the antrum may result in nasal occlusion, nasal occlusion is attended by mouth-breathing, mouth-breathing may be followed by displacement of the teeth. To use another figure this sequence may be looked upon as a "Round-robin." It begins with a diseased tooth causing antral disease and ends with the orthodontist treating an effect directly traceable to a dental cause.

I am tempted to continue, but enough has been said to show that these two specialties, yours and mine, are so intimately related that for either of us to neglect the other is to cause the failure of both. We certainly should adopt as our slogan that old familiar motto, "United we stand, divided we fall." The dentist has helped me out of many a tight place, and if my specialty can serve the orthodontist I shall rejoice and be glad.

The Deformities of the Superior Maxilla from the Standpoint of the Rhinologist.

By C. H. Kohler, M.D., Minneapolis.

In the volumes of literature which have appeared from time to time on this subject, hereditary influences and degeneracy have been given much prominence. However, despite all that has been written I doubt that the exact bearing which heredity has upon these deformities, is as clear and explicit as it should be for a thorough comprehension of the subject. It shall be my purpose, therefore, to consider briefly the condition in its entirety from the remotest hereditary physical and psychic causes throughout the successive stages to the ultimate effect.

Heredity.

The term heredity is applied to that natural law of living organisms whereby their characters, qualities and tendencies are transmitted to their offspring throughout successive generations. The tendencies are of two distinct types, one affecting merely the functional relations of the organism, while in the other there result actual tissue changes.

In a general sense man, like other distinct species, is much the same as his fellow creatures, yet each individual differs in some respect from every other member of his species who now exists, or ever has existed, or it may be assumed ever will exist. No matter how much two individuals may appear to be alike, even when seen in the wonderfully striking likenesses, such as may exist in twins, yet, when this resemblance is so strong that they can only with difficulty be told apart, there is a fundamental difference of nature which nothing can change or eradicate. Association, education and environment may and does have a marked effect upon these types of strong personal resemblance, yet fundamentally there are radical differences of mind and matter which nothing can change.

Each is under the dominion of the natural law of evolution of his antecedents, of which he is the consequent, and thus there is a destiny made for man by his ancestors, which no one can elude.

The power of hereditary influences to determine an individual's nature has been known to all ages. In every age and country in which science has flourished there have been men who have devoted their lives to a study of this subject, and have felt that their hard-earned results could scarcely be called a beginning. So vast is the field, so many are

the phenomena, that the province of natural science is practically infinite, for each animal and each plant presents special problems which open in endless vistas before the student. Theories in explanation of heredity have been advanced from the earliest times, and scientists have differed widely in their views, but, up to the present time, nothing of a perfectly satisfactory nature has been given to the world.

About 400 years B. C., during the life of Hippocrates, generally styled the Father of Medicine, Democritus offered a theory that all parts of the body contribute to the "seed," and as a result the offspring was similar to the parent. More than 2,000 years later in the eighteenth century, Bonnet and Haller advanced the "Preformation Theory." During the latter half of the nineteenth century Spencer gave us his theory of "Physiological Units," Darwin his of "Panganesis," and Prof. Aug. Weissman, the theory of germ-cells or germ-plasm. And, while more than 2,000 years have elapsed between the first and last three named, the latter are probably as far from right as that of the *confrere* of Hippocrates, for they all ignore one or more of the essential conditions necessary for a perfect explanation.

While we have no present day theory which can be called a theory, *per se,* we have nevertheless reached some well-defined conclusions which differ radically from any theory ever formulated.

In considering the subject of heredity, it is necessary in order to proceed lucidly and logically to discuss the inherited tendencies from the standpoint of health or the *normal,* and of disease or the *abnormal.*

Normal Inherited Tendencies.

It is hardly desirable here to take up much time in considering the normal inherited tendencies, for the subject which I discuss here today has to do entirely with the abnormal. However, to emphasize the importance of giving due weight to hereditary influences, I recall to your mind a few of nature's strongest characteristics in the evolution of mankind. Of first importance are the extrinsic conditions of environment, education, habit, parental influence, etc., which govern the life of the individual or being, and are the dominating factors in the mental and physical evolution.

Man, like every other distinct species of animal, originated probably from a common stock and the races and nationalities are merely deviations from the original because of the conditions previously mentioned. What is merely an acquired habit in the parent may become instinct in his progeny. "Habit," it is said, in us "becomes second nature;" it can be as truthfully said that in our children it may easily become *first* nature.

Each of us by a certain mode of life, education and environment has become a modification of the original type.

The well-bred bloodhound or the "pointer," or any of the standard-bred dogs of distinct and peculiar characteristics, was probably in remote ages just plain dog, like its degenerate brother the common yellow cur, proverbially the most useless of useless specimens. I wish to convey to you in other words that they have inherited with constantly increasing tendency the predisposition of their progenitors, just as the child inherits a predisposition to some strong mental or physical characteristic of its ancestors.

All these things, however, are so familiar to you that I shall not dwell on them further, and have recalled them to your mind mainly to emphasize the powerful influence of heredity and the necessity, therefore, for a comprehensive knowledge thereof in the conditions which I shall now consider under the other heading, the abnormal or diseased types, which lead to the subject proper of this paper.

Abnormal Inherited Tendencies.

In considering the abnormal type we say that deviations from the normal are due to influences, extrinsic and intrinsic, affecting function, which in turn affect structure. The changed functions and structures thus inherited become integrated throughout successive generations, and create, modify or obliterate physical and mental characteristics.

We consider disease hereditary in two distinct forms; 1st, where the inherited condition exists in a weakened vitality, or lack of normal resistance in some tissue, and which we speak of as a *predisposition.* Here the *functional* activity of a tissue or organ is mainly at fault and is more vulnerable to diseased change or infection. 2d, where there is a direct transmission of an organically defective tissue or organ.

This distinction will do for practical purposes and we may thus consider inherited diseases under these two heads. To be absolutely accurate, however, this could not be done, owing to the lack of an exact knowledge of heredity as heretofore spoken of, and also to conditions where both causes seem so thoroughly intermingled that we cannot say that they belong essentially to either class. I can best illustrate the types referred to by naming a few diseases belonging to each class. In the first class, tuberculosis, gout, rheumatism, cancer, hysteria, etc., are the diseases in which only a *predisposition* is inherited, this predisposition being a tissue of lessened vitality, lacking in the power of resistance to the invasion of disease or germs, lying latent, and in a sense, harmless, but a fertile soil for radical change under the proper provocation. Until a few years ago

it was considered that consumption was directly inherited; that a poison, or diseased cells, were directly transmitted from parent to offspring and remained latent or inactive until the vital forces were in some way weakened, when they suddenly developed into the disease proper. Now, we know that this is not correct, but that a specific germ, the bacillus of Koch is necessary, with the proper tissue soil, for its development.

A case in point is one I saw reported recently. A family of seven children had a tuberculous father and mother. The second and fifth child never lived with the family, and not alone showed no symptoms whatever of consumption, but had healthy children of their own. The other five children under the same roof with the father and mother, and therefore in an infected atmosphere, all died of the disease. There are numerous other instances of individuals of tuberculous parentage passing through life without any sign when removed from the source of infection.

In the second class we have syphilis, physical deformities of the teeth, hare-lip, club-foot, cleft palate, etc., errors of vision, like near-sight (due to an elongated eye-ball), a number of skin diseases, etc., all of which are directly transmitted and in which there is organic change in certain tissues. Syphilis differs from the rest in that a poison is probably transmitted through the blood. In some cases we have a complication of the diseases named in the first and second classes, or diseases which belong to both classes, rather than to either, such as asthma, hay-fever, etc. In asthma and hay-fever we have the functional and the organic condition combined.

Influences of Environment.

Individuals with acquired degenerate conditions are capable of transmitting to their offspring a predisposition to such degenerations. Bad hygienic conditions, as filth, poverty, starvation, overwork in ill-ventilated rooms, want of pure and wholesome food, are important factors in producing degeneration. The acquired ailment of the parent becomes the inborn infirmity of the offspring. As an illustration let us imagine twin brothers who have entered the world as like as possible. Send one of these infants to a farm home to be brought up and let the other be reared in the slums of a city, in the midst of poverty and vice, and what will be the result? The one who breathes the pure air, feeds on plain but wholesome food, does an honest day's work every day, will reach manhood full of health and strength, while his brother, bred in the slums seldom, if ever, breathing the pure air and fed on food wanting in many of the essential constituents, of wholesome diet, will arrive at manhood, should he reach that age, a physical degenerate, no

more like his twin-brother in the country than Hamlet was like Hercules. Here we see the effects of environment upon the physical life, and no more proof is needed to make clear the fact that its effect upon the mental and moral nature is equally powerful. As the physical health can be developed and preserved only by good habits, nutritious food, pure air and exercise, so the mental faculties can be enlarged and brightened only by education and *example*. Hence, "Heredity and environment are masterpieces of the organic world; they have made all of us what we are."

Fortunately, Nature makes a wise provision in her tendency to "throw back" or revert to the *normal*. If, for instance, one parent be perfectly healthy and from a healthy family, while the other parent is unhealthy and from a degenerate stock, a reversion to the healthy will, in all probability occur in some of the children at least. On the other hand, if both of the parents are degenerates of the same or different varieties of degeneration and from degenerate families, their offspring must necessarily retain their parents' peculiar characters, and when these characters become extreme, the stock dies out and the family becomes extinct—an example of the "survival of the fittest."

Now you may ask how this particularly concerns the title subject which I am here to discuss, and I answer, in a word, that it shows us the constitutional conditions which, in my opinion, have so marked an effect on maxillary deformities, and as well makes plain that these causes must be considered in order to properly treat so many of the deformities which come to us for help.

To make the advance which is possible for a progressive profession every dentist who aspires to be in the *progressive* class must learn that he is not limited in doing good by mechanics and mechanical ingenuity. An esteemed colleague for illustration, in a book published within the past year devotes four hundred pages to causes wholly theoretical and two hundred pages to treatment, *all* of a mechanical nature, *and a half a dozen lines to the treatment necessary for conditions which are responsible for* 50 *per cent of the irregularities.* What seems so strangely inconsistent in the aforesaid colleague, is that he should devote four hundred pages and even whole books to constitutional causes and then after telling us all about the baneful effects, to pass by absolutely anything which would correct these causes and, ignoring them entirely, write page after page on mechanical correction of the irregular or deformed teeth.

Influence of Disease on Deformities.

I shall now take up a consideration of the diseases, and give you my idea of the way in which they affect maxillary deformities. Of practical interest are all congenital nervous diseases, tuberculosis, syphilis, gout, chronic alcoholism, idiocy and imbecility. These

diseases and the inherited tendencies thereto we call the indirect causes of maxillary deformities.

A child with parents, or even remote ancestors, suffering from one or more of these diseases, begins life even before birth, in fact, from the time of its conception, under adverse conditions; certain tissues are, at the very beginning, below the normal in vitality and natural resistance. As a result they are either born as before stated with a *predisposition* to invasion of disease, or with the disease itself already a part of their constitution.

The child in utero, in its embryonic state, develops with certain tissue of an inferior quality which does not attain full structural and functional perfection. We know it to be a physiological fact that this is true and that tissue in one organ can come to full structural and functional perfection while other tissue or organs in the same body remain undeveloped. This tissue we speak of as abnormally non-resistive to disease, because it has not attained its maturity or has undergone a temporary or permanent retrogression. Where this predisposition exists at birth or develops later there is a very strong tendency to cell-proliferation in much of the tissues of the lower type. For instance, fatty and connective tissue are of this type and the cell and fibre of these tissues may be organically perfect at birth but in cases where an inherited weakness exists these tissues show the greatest tendency of any tissue to cell-proliferation. It is this type of tissue which constitutes the diseased conditions which I contend are such important factors in the faulty development of the maxillary bone.

The diseased conditions which we speak of as adenoids and enlarged tonsils, or hypertrophy of the tissue in the nose, are made up entirely of this inferior quality of tissue and oftentimes at the expense of tissue of a higher quality. Thus you see that cell-proliferation and the consequent enlargement of the tissue is due to two causes; first, the general or constitutional weakness, where the tissues in general are lessened in vitality, awaiting only an exciting cause; and second, because *the lower type of tissue attains maturity first and develops excessively under the slightest cause.* Provocation for the development of diseased conditions in the nose comes very early to a surprisingly great extent as we shall see later, when we consider these topics under the head of direct causes. The higher type of tissues, like the brain cortex develops much more slowly and is the last to attain maturity and perfection and for this reason has comparatively little to do with the early development of the troubles of which we speak. Sometimes this lower tissue takes the place of a higher grade or the higher qualities suffer retrogression and then

we have other conditions manifested. For instance, if some vital spot in the brain is affected we have some defect in the special senses, or if the diseased condition is general throughout the brain, we have imbecility. If the spinal cord be affected we have a faulty development of some part of the body, or a lack of coördination, and some spinal disease becomes manifest. If the defect be of a general nature, affecting more or less all the tissues of the body, idiocy is the result; or, if the tendency be less marked we have what we generally understand by the term scrofula, or a gouty or syphilitic or other diathesis, or possibly only a lymphatic temperament. But whether it be of a slight or great degree, the *quality* of the tissue is at fault, and wherever the quality of the tissue is below the normal, the tendency for the development of adenoids, enlarged tonsils, polyps and other hypertrophies of the nose is increased. This means that where you find the constitutional defect, you find coexisting the abnormal tissues in the nose or naso-pharynx, which cause defective breathing, and these conditions are apparent for months and even years before you find any change in the upper jaw of an abnormal nature. Among the commonest affections all over the world, among healthy and unhealthy alike, are troubles of the nose and throat, the most common of which is the condition we speak of as "cold." Everybody practically from infancy suffers at more or less frequent intervals from simple coryza, mainly for the reason that this is nature's method of throwing off the disturbed relations of the body from the process which we undergo when we have "taken cold." Two conditions particularly predispose us to colds; a general depression of the system or a decreased vitality of the nasal membranes. This fact is so generally known that it requires no proof or elaboration, and if you will grant this you will see why children with the inherited local and general weaknesses of which I have spoken, must of necessity suffer frequently from cold and that the cold is the necessary local irritant for the cell-proliferation of the defective tissue in the nose and throat. The general and local conditions are fertile soil for the development of nasal obstruction upon the slightest provocation and when every child suffers from that provocation it is not hard to understand why nasal conditions are so important a factor in maxillary deformity. In what I have said so far, I have tried to cover the predisposing causes which, in the table herewith presented are under the three heads, climate, hygiene and constitutional weaknesses, these being the *indirect* causes which are responsible for what I have termed the direct causes; namely adenoids, enlarged tonsils and nasal hypertrophy. There is still another class of diseased conditions which, with the last three named should come under the head of direct causes; namely, the septum and its diseases.

Deviations of the nasal septum are just as important as the other conditions named, because, like the other trouble the disturbance comes from infancy or early childhood.

Deviation of the Nasal Septum.

Of the three causes mentioned above, adenoids and deviation of the septum are of the greatest importance, and it is my opinion that the majority of the severest forms of constricted vault have their primary origin in the deviations of the septum. This condition begins very early in life, and generally results from falls on the nose. As soon as children are able to crawl or walk, more or less severe bumps on the nose are of frequent occurrence. If a blow is of sufficient force, some part of the cartilage is likely to yield by deviating to one or the other side, and the growth of the child develops this deviation in its unnatural lines.

If this proves to be a marked deviation, trouble arises from two sources; first, from its tendency to develop hypertrophic tissue in the nose, or adenoids in the naso-pharynx, or if the amount of deviation be sufficient to limit greatly the space in one or both sides of the nose, the breathing becomes defective from these perverted influences; and, secondly, the hard palate loses its natural support from above, and when the mouth-breathing begins we have necessarily the dropping of the lower jaw, the pressure of the cheeks on the alveoli, displacement of the tongue, elevation and retraction of the upper lip, *and the perverted influence of the muscles of mastication.* Thus the constriction of the upper jaw begins and goes on, till the eruption of the permanent teeth with insufficient room in the unnaturally small space allotted to them, which, by their pressure, aid in causing the different varieties of constricted vault, and to some extent the irregularities.

Adenoids, Enlarged Tonsils, Hypertrophies.

We consider adenoids, enlarged tonsils and nasal hypertrophies as one, because they all cause trouble in the same way, by obstructing the normal air passages, thus making mouth-breathing imperative, differing only from the second class in that the hard palate has its normal support from the septum.

The indirect or constitutional causes are of importance only so far as they bring about the conditions just enumerated under the head of direct causes. In other words, if, for instance a child is born with a strumous or syphilitic diathesis, or is idiotic, certain tissues as a result develop excessively. The tonsils enlarge and adenoids or hypertrophy in the nose develop, because this very tissue, being of an inferior quality, takes the place of the normal tissue, and makes the child one of lessened vitality

and inherent weaknesses. The nares as a result become occluded, mouth-breathing supervenes and here we pass into the first class, or direct causes. Or, in instances of this type, where there is already slightly defective breathing in a child who has passed the age of infancy, a fall or blow on the nose of considerable force bends the still yielding tissues of the septum, and then such an accident at once throws this patient in the more serious class where the resistance of the septum is gone. These conditions arise generally previous to the tenth year, and the child who lives to this age and breathes properly, rarely has an irregularity or deformity of even a reasonably marked degree, except possibly as the result of an accident. This, in my opinion, if I can substantiate my position, is the best proof I can offer you that defective breathing precedes most decidedly any other etiological factor, except constitutional tendencies, and that the other causes, such as crowding of the teeth, are entirely secondary.

My reason for believing this I shall now endeavor to explain more fully. In certain text-books much emphasis is given constitutional causes, such as malnutrition and the inherited tendencies, these conditions being given as the direct causes of deformities owing to crowding of the teeth, which in turn it is stated cause the difficult breathing and subsequent deformity. The question arises therefore as to which is the cause and which the effect. To ascertain which position is correct it is only necessary to settle conclusively which condition comes first. As I said before, you can always find the difficult condition in breathing long before an irregularity in the teeth manifests itself, and that is why I consider constitutional conditions of importance only in so far as they cause disturbances of the nose.

In statistics carefully gathered from about fifty institutions of the deaf, dumb, blind, feeble-minded and insane asylums, located in this country and in Europe, we find that 60 per cent of the inmates have some deformity or irregularity of the upper jaw and that all have one or more of the conditions which cause defective breathing. This means simply that where any condition of degeneration exists, resulting in blindness, deafness, mutism, idiocy, etc., the very reason for this degeneracy exists in the weakened defective tissues in some spot, which in the nose or throat develops into adenoids or other nasal obstruction, producing defective breathing as a consequence. In proof of this you will find that the lower animals or the savage races have these deformities only in a very small degree, the reason being largely constitutional. In the first place their general nutrition is very much better, and in the second, they have few of the inherited tendencies to which I have referred. In any race, no matter how enlightened or savage, where you find decided con-

stitutional disturbances, you will find deformity of the teeth and vault, but you will also find, preceding the deformity, one or more of the three principal nasal deformities to which I have referred.

Among idiots, deformities are so common that we have a typical idiotic face, due almost entirely to the condition we find in mouth-breathing. Add to the dropping of the lower jaw and separated lips, a slight drooping of the eyelids, and we have the expression commonly called idiotic.

Another phase of this question is noted by certain nerve specialists who assert that the "V" and "saddle-shaped" vaults tend to increase or even develop a mental defect by limiting the cranial capacity. That, in other words, as the vault becomes constricted, the pressure of the vomer becomes so great that the cranial bones contiguous with it are forced higher in the cranial vault, thus constricting its contents. We have reliable cases on record in which this pressure in extremely high vaults, with a resisting septum, pushed the inferior wall of the cranium high up into the cranial vault, and so retarded the development of the brain that different forms of mental derangement resulted, differing in degree from slight forms of dementia, to cases of radically incurable insantiy. Now while the extreme conditions may be seldom met with, it should teach us that if it has only a slight effect in many cases in retarding the cranial development, it is a matter of such vast importance that we cannot afford to overlook it. Probably I should state before going any further that a perfectly straight septum rarely exists and that practically everyone has some slight deviation or, if not really a deviation, a cartilaginous or osseous projection on one or both sides.

You see, therefore, that the patient suffers in two radically different ways. If the septum is straight, there is likely to be damaging pressure in the brain. If it deviates, the breathing becomes defective from causes already stated.

In this same connection I wish to speak of two other conditions having a strong bearing on this matter, these being the anatomical changes which evolution seems to be bringing about. I have noticed in your textbooks the statement by different writers that the jaws of people today appear to be much smaller than those of our ancestors. If this be true it may account for the crowding of the teeth and the irregularities in general. Another explanation for the existence of so many deflections of the septum is in the same line. The explanation I have in mind is from one of the most eminent anatomists of today, who believes that in the past our ancestors had much larger and more roomy noses. In the process of evolution, as we have become more and more civilized, the

space for the vomer and ethmoid have become less and less, while the bones themselves have remained the same. Being too large for the space allotted to them, something has had to yield, hence the deviations spoken of, or the increased pressure on the cranial bone.

It was my intention here to take up the deformities of the inferior maxilla, with special reference to its effect on deformity of the superior bone, but I understand that there are several papers to be read on malocclusion which, it is safe to assume, will cover the subject much more fully than I think advisable here.

Retarded Development. I should like, however, in passing, to call attention to the very important bearing which a retarded development of the inferior maxilla has in the cases of malocclusion. In the nasal conditions spoken of, one of the early complications is a tardy growth of the lower jaw, and when it is remembered that this lack of development affects the entire bone, you will readily see that a very slight change in size will throw the teeth out of the line of occlusion. This will be better understood by directing your attention for a moment to the changes in the bone with age. Anatomists tell us that these changes are so ordered that the gums or teeth shall meet in biting. At birth the angle is about 175°, showing only a very small curvature, so that the resemblance to the same bone in adult life at 110° is surprisingly slight. The greatest change occurs in early life. At infancy it is about 175°, at four years about 140°, and at eight about 120°, so you will see that this is the period of stress and anything that interferes with these necessary changes must have a marked effect on satisfactory occlusion. The dropping of the lower jaw in mouth-breathing from the very position the jaw assumes is, in itself, sufficient to interfere with its development. The reduction of the angle does not occur as rapidly as it should, due largely to the changed relations of the articulation. With the jaw constantly dropped the condyle assumes an unnatural position, and in a very short time occlusion is impossible. It then naturally follows that with the lower jaw in faulty position, the superior maxilla is without proper occlusion and must of necessity develop under adverse conditions. However, as before stated, it is not the province of this paper to go into the deformities of the inferior maxilla, but I desired to call your attention to the fact that the deepest invesigation and closest scrutiny into the causes will, in my opinion, lead you in the end to, and can be properly accounted for by, the mouth-breathing theory.

Another condition worth consideration is the effect that ossification has on the maxilla, in these cases of perverted development. Too little attention has been given this very essential matter and I believe future research along this line will reveal much of importance on malocclusion.

Nothing in particular is said in our text-books on anatomy, on the centers of development, except possibly, that which includes the four incisors. This is the last one to become ossified to the palate process and its junction to the line of molars is the last stage in the final development. For this reason when the molar process becomes fixed the front teeth must, to a certain extent, find space as best they can so that where a narrowing of the diameter between the molars exists the room for the incisors is limited and their growth then is naturally in a forward direction. The retraction of the upper lip removes the natural pressure from the front, the muscles of mastication act with perverted pressure, and thus intensify the unnatural development. This condition absolutely never exists where defective breathing is not present.

I have made this statement many times to a number of my friends in your profession, who did not wholly agree with me, in discussing these conditions, but they have yet to show me an exception to this statement. Traced to its earliest source it is impossible to find that mouth-breathing does not precede any other direct causative factors which result in a deformity of the teeth, except those herein mentioned.

I contend therefore that mouth-breathing in its fullest sense is the most important etiological factor in maxillary deformities, and in looking for a practical solution of the problem for correcting these difficulties, among the essential considerations will be the conditions that *directly* and *indirectly* are responsible for defective breathing. As before stated, defective breathing is caused mainly by one or more of the three conditions—deflection of the nasal septum, adenoids or hypertrophic tissue in the nose. Did none of these conditions exist, it is my opinion that the dentist would rarely see a "V"-shaped or "saddle-shaped" vault, for in ten years of private practice and in the hundreds of cases I have seen in clinics, I have yet to see a faulty vault in which one or both of these conditions did not exist, and I hope to show you that this is the cause and not the effect. Adenoids frequently become apparent at birth, and I have removed large masses in children from one to two years old. It is occasionally necessary to remove enlarged tonsils as early as the first or second year, and as I have told you before, deviation of the septum often results from a fall so early in infancy that the patient, when grown up, has no recollection of any injury. *On the other hand, it is very rare to see a faulty vault under five years and generally it does not begin to show much before the eighth or ninth year.*

A positive proof of additional value in contradiction of the argument that crowding of the teeth is responsible for these deformities is the fact that there are a great many vaults *in which there is absolutely no evidence of any crowding of teeth, coexisting with V-shaped vaults and like de-*

formities. I have a large number of models here, which I can show any one interested, of the most perfect teeth, regarding position and apposition with absolutely no evidence of crowding and yet in which there is a very high V-shaped vault or other irregularity, the deformity being unquestionably due to defective breathing. Until some one can successfully controvert this statement I am going to continue to believe that it is the other fellow who is wrong. There is one exception to these conditions, in the marked irregularities of the typical variety where the teeth come at random and seem to spring from any part of the alveolar process. In some of these cases there is no evidence of defective breathing or any particular deformity of the vault. Here the constitutional taint is wholly at fault and malnutrition, arrested or perverted development, or perverted arrangement of the tooth germ, is responsible for the irregularity. In these cases the faulty inherited tendency is so very apparent that the correct etiological factor is seen at a glance.

The two particular reasons advanced in opposition to the position I take, particularly on the part of one very prolific writer who has made this subject his life-work, are crowding of the teeth, which has already been considered, and the fact made very emphatic by him, that there are no irregularities or deformities with the first set of teeth. This assumption is positively wrong as the experience and investigation of hundreds of dentists will show, but it is probably correct to say that they are infrequent. The reason for this, in my opinion, is very plain. The first and most important is that the temporary teeth are in no sense a part of the maxillary bone, as compared with the permanent teeth, and are in position long before any of the baneful effects of defective nasal conditions manifest themselves. The germs spring from tissues which are comparatively superficial and of a soft and spongy nature while the germs of the permanent teeth are high up in the process and begin to be affected in their descent. It is further true that the muscles of mastication do not become active early enough to affect the temporary teeth but become very active during the descent and eruption of the permanent teeth and here the buccinator becomes a very powerful factor, particularly in the saddle-shaped variety of deformities. It is not alone the pressure of the cheeks in the dropping of the lower jaw, in mouth-breathing, which is so harmful, but the great pressure of the muscles used in mastication which makes a slight condition a prominent one as soon as the occlusion is not absolutely perfect. This is very marked in models such as I have here where the pressure of the buccinator is so apparent that it will hardly leave anyone in doubt as to the influence it exerts.

Before going into a few conclusions, I wish to give you a brief resumé of all that I have said above, which I think is made very simple by

the following table. As will be seen, the constitutional defect, with adverse hygienic or climatic conditions are responsible for adenoids or nasal trouble as the one element, and conditions of the septum in disease as the other, result in mouth-breathing and the latter in turn causing the conditions which follow:

Malnutrition,
Lymphatic Temperament,
Blindness, Mutism, Deafness,
Neurotic Tendencies,
Strumous, Syphilitic and
other diathesis,
Imbecility,
Idiocy.

Climate. Hygiene. Constitutional Weakness.

Adenoids,
Enlarged Tonsils,
Nasal Hypertrophies.

Injury. Excessive size of vomer and ethmoid.

Deviation of septum.

MOUTH BREATHING.

Dropping of the lower jaw which is followed by retarded development of the bone, excessive pressure of the cheeks on the alveoli and elevated and retracted upper lip. Displaçement of the tongue from superior maxilla. Perverted action of the muscles of mastication. Contractions of nasal fossa and upper jaw.

Typical and Atypical Deformities.

"V" or "Saddle-shaped" vault. Irregularities

Excessive pressure on septum.

Deviation of septum or pressure on base of brain.

Necessity of Nasal Treatment. Now if a constitutional tendency or a weakened tissue predisposes one to these nasal disturbances and these precede deformities of the vault or teeth, what can be more rational than first to do everything within our means to improve the condition of the tissue, by checking or eradicating the constitutional weakness and then, if this can or cannot be done, correct the difficulties of respiration which predispose to and precede maxillary deformities, and *lastly* resort to mechanical means necessary for the correction of the teeth?

Now, if my conclusions are wholly or even in a measure true, think of the people who are permanently injured by not having everything done within the power of the dentist, or the nose and throat or other specialist, in correcting these deformities; and not alone the physical injury, but the unsightly physiognomies resulting therefrom. It seems to me therefore that a radical mistake is made when all these causes are not taken into consideration. The first mistake is made by the family physician who allows this to escape his notice long before the dentist or the nose and throat specialist has *anything* to do with the patient. But I think the dentist is at fault and does the patient possibly an irreparable injury when he considers that his work is all that is necessary and does not know, or if he does know, neglects the other conditions present, which must be corrected before an ideal result is possible. Many of our text-books, and I judge therefrom, your teachers, devote everything in the nature of treatment to mechanical means. This appears to me wrong, even from their own conclusions, because where a constitutional defect exists this must first be corrected, or at any rate improved, to attain a satisfactory result. And if my position is, in the main, correct as to the direct causative factors, they are doubly wrong to advocate a correction of the defect by treating the effect and ignoring the cause, when that cause makes your mechanical efforts practically futile, while a correction of the cause would in itself arrest the progress of the deformity and make your treatment much more simple and effective. I believe that the removal of the cause, which I deem defective breathing in its full sense, will do more for the correction of the deformity of the jaw, unaided by mechanical means, than you can do by any mechanical means unaided by a removal of what I deem the cause. But used together, we have the most certain means for obtaining the most perfect results.

A case in point is one that came to me about four years ago. One of our ablest dentists began with this patient when she was eight years of age to correct a very bad irregularity. In about a year's time he had accomplished all he thought necessary. Three years later she came back to him *with almost as much trouble as she had in the first place.* He again corrected the condition, taking nearly a year for the work. At the age of fifteen her teeth were again decidedly irregular and her father wanted her to go to the dentist again. She, however, by this time realizing that she had a very troublesome condition of the nose and throat, which made mouth-breathing imperative, rather insisted that the money and time be spent for that. She was thereupon sent to me and in about three months time I corrected the nasal condition so that she breathed properly. Immediately following the conclusion of my treatment she was sent to the dentist and her teeth again corrected. Three years have now elapsed

and her teeth are in better condition than when the dentist discharged her the last time.

It is always a matter of particular regret in presenting a paper of this kind that the time is too limited to more than touch upon many of the conditions which require extensive consideration. One cannot help but feel that even with the most persistent efforts in condensation and brevity we are likely to tax the patience of our auditors, indulgent and interested though they may be. I should like to elaborate upon the constitutional conditions, particularly in the efforts necessary to improve the conditions as we find them, but I will of necessity consider this essentially in the domain of the physician. I deem it advisable in my concluding remarks to say also that I have purposely stated my ideas and position from the standpoint of the rhinologist in its strictest sense, realizing full well that there is a great deal to be said from the standpoint of the dentist which I have not touched upon, because that is essentially your domain, and I could add nothing of interest or value to you. Until the people are educated to the point to voluntarily marry with a proper consideration for the wellbeing of their offspring, or until our laws shall successfully interfere where this is not done, so long will the unfit be begotten and immense avoidable suffering continue in the world, the "sins of the parents being visited upon the heads of their children." To the thoughtful observer it is very distressing to see educated men and women who have reached years of discretion, where good judgment should prevail, so completely and selfishly ignore the laws of heredity, but so long as these conditions prevail we will have to contend with the diseases we are here discussing and meet them as best we can. This I believe is best accomplished along the lines herein stated.

Discussion.

Dr. Angle. You have listened to the reading of two very excellent papers and I am proud of them. It seems to me one of the very promising conditions of this society is that we can meet and discuss just such problems as these which have always perplexed us as orthodontists. We can discuss matters in which we have been so far apart in the past, and the orthodontists and rhinologists can meet and discuss the questions of interest to them.

Dr. Casto. was called on and replied that he would like to ask a question, and said to the essayist: In speaking of heredity, I believe you said that in specific instances, in specific diseases as in syphilis, that it was transmitted by means of the blood?

Dr. Kohler. That is not known; it is supposed to be that.

Dr. Casto. How about transmission from the father; can that take place?

Dr. Kohler. The transmission comes either direct from the father, or the mother becomes infected and then it is from her. It can come in either way.

Dr. Watson. Just a word regarding a single statement made by Dr. Kohler.

He, like many other writers, states that there is little, if any, malposition found in the deciduous teeth. That the percentage of pronounced malocclusion, in the deciduous teeth, is infinitely less than in the permanent ones, is unquestionably true, but "little if any malocclusion is found in these teeth," is a statement which, I think, is not sustained by careful observation. I have seen excessive "upper protrusion," in a child less than three years of age, and a great many cases of a milder type, especially those belonging to Class I. (Angle Classification.)

If the statements of writers of former years concerning this subject are reliable, then, either malocclusion of the deciduous teeth is becoming more common, or my experience is an unusual one.

Dr. Kohler has failed to recognize the fact that there are different forms of malposition of the teeth. We believe, I think almost to a man, that a certain type of irregularity is always preceded by nasal occlusion, by mouth-breathing, that is that type of irregularity in which we have protrusion of the upper teeth and narrowing of the arch and lack of development in the lower jaw. But that there are other types of malocclusion of the teeth which are in no wise associated with any nasal or post nasal obstruction is absolutely beyond question.

Dr. Copeland. You orthodontists form such a mutual admiration society that you are not disposed perhaps to attack the Doctor and myself. So far as I am concerned I am not used to this kind of treatment. Ordinarily when a paper is read I expect at least two-thirds of the people present to take exception to every statement made in it, and to be agreed with so fully is rather disheartening.

But I would like to hear from you gentlemen who know whether it is true or not that you always have mouth-breathing before you have irregularity of the teeth? Is it true that you have mouth-breathing in all cases of irregularities of the teeth? (Some one answered, No, not always.)

As a general proposition I do not believe that mouth-breathing is the sole cause. At least so far as the septum is concerned there are other

causes for deflection, and if I had time—I wish I had a week, because it would take that long I suppose—I would like to discuss this whole subject of heredity and degeneracy. I do not believe you orthodontists are treating a lot of degenerates. I do not believe you want that to be your business and I think there is a reasonable explanation other than that of heredity and degeneracy. I do not believe it is true that malposition of the teeth is transmitted to the offspring and there is plenty of testimony to refute that idea.

The Doctor in his paper spoke of this malformation as being very common in feebleminded people and idiots. We know that the condition of feeblemindedness or idiocy may be due to reasons physical rather than mental. There may be too early union of the sutures of the skull so that the brain cannot develop, but I do not believe there is *direct* relationship between degeneracy and the malformations under discussion. I believe there is another way to explain it and I wish you gentlemen would discuss that and certainly if you have cases of malposition of the teeth unaccompanied by mouth-breathing, patients who have never been mouth-breathers, Doctor Kohler's theory is overthrown. I believe there is a large proportion of these cases which are due to too early fusion of the basioccipital and sphenoidal bones.

I agree with the Doctor, of course, that many cases of malocclusion are undoubtedly due to mouth-breathing. But this cause alone leaves a great number of cases unexplained. What about these?

Dr. Brady. I will have something to say as the discussion has taken this form. There is about twenty-two per cent of the total number of irregularities that is due to mouth-breathing. There is some sixty per cent of the total number of cases due to another cause which has absolutely no connection with mouth-breathing in any way. (Some one asked: What is it?)

This cause is such a large one that I cannot explain it in a word or two. It is really the thing that I intended to present at this meeting, but I have not been able to get the material in proper shape to present it. I hope that at the next meeting of this society I will have it ready, and that I will be able to show a satisfactory cause for nine hundred and ninety-nine cases out of a thousand—the other one I will not attempt to account for.

And when I do account for the nine hundred and ninety-nine cases, I will put sixty per cent of them in one class, and prove that they all come from the same cause, and this cause is not even remotely connected with mouth-breathing. In mouth-breathers the arch is always of a certain definite shape, so that it is recognizable at a glance. It varies only in degree, not in form.

Tomorrow my charts will show my observations in this direction; I believe I have a point or two to offer which is new even to orthodontists that have been talking on this subject for long years.

Dr. Angle. Before passing the subject I feel like thanking Dr. Kohler personally; to think that a man should come fifteen hundred miles to read a paper on a subject in the interest of a branch of science apparently so remote from his own class of work; he is certainly entitled to respect and appreciation to a very high degree. Still I cannot agree with his statement that mouth-breathing precedes all cases of malocclusion. I think he will have to change his opinion in regard to this, yet that one statement will make us think a little closer.

I am delighted with such a carefully prepared paper. It will give us a chance to study. There was so much in it I could not follow it all. I will read it over closely when published and I will be proud that it was given before this society. I wish to thank Dr. Kohler personally.

Dr. Kohler. I would like to say that it is a matter of surprise to me to find that I have so many auditors who agree with me, for you all seem to do so in a general sense, if not willing to think as I do in all that I say. I live in a section of the country where our thought is largely dominated by a man who takes the opposite position in almost every sense, and while I have read papers on this subject before other societies at different times along the same lines, I have always been attacked almost viciously. It is a decided pleasure therefore to find that there are people in the world who look upon it from my side, and I think it is only a question of a little time when there will be more. There are too many minds at work to be very long in doubt as to the causes of these deformities and I am very sure from what I see here today that the minds coping with this subject are as capable as those which have been working on the other or contrary side of the proposition.

I would like to say that I purposely made my remarks in this paper from the standpoint of the rhinologist in its strictest sense, having made it rather partial than impartial, believing that the discussion following would bring out anything neglected from your side. This is particularly for your interest because of the radical position I assume. I wished to bring out everything there was to bring out from the standpoint of the rhinologist, realizing fully how much there is to be said from the standpoint of the dentist.

The Doctor who spoke about the nasal septum and expressed a doubt that children did not very often fall on their noses in early life is very much mistaken there. You will realize this if you stop to consider that a

man's nose is the most prominent part of his face, and that in the first few years of life children in crawling about and learning to walk get blows on their noses from one to a dozen times a day. Many times they are not of sufficient force to call attention particularly to the nose, but it is not an unusual occurrence to have them suffer so that the attention of the parent or nurse is called to it. The septum in infancy is a very weak structure, almost entirely cartilaginous. We can easily understand how a blow that is not of sufficient force to deflect or break it will, by the injury inflicted, cause an influx of blood, and some slight injury be the seat of a deviation later in life.

The most natural thing in the world is to have just a slight deviation or a little knot on one side or the other; just enough to cause it to develop along the lines of that little irregularity. It is one of the most unusual things in the world to look at the nose of a child and find it without some slight deviation, or a little knot or shelf that will develop if you start it up in the slightest.

I do not think that blows on the bridge have much influence, for when on the bony structure they must be of sufficient force to actually cause a fracture. It nearly always begins in the cartilaginous part of the septum, but frequently affects the bony tissue in the process of ossification.

I should like very much first to hear about Dr. Brady's idea of some heretofore unconsidered cause which he says is responsible for sixty per cent of the cases, and of course I shall have to defer an opinion until I hear what he has to say, but I think I dare venture the opinion now that I can trace the causes he gives to defective breathing in the sense given in my paper. I should say, too, that the conditions I have spoken of are in a certain sense *typical* irregularities, and it is the *atypical* cases mainly which are caused by conditions other than defective breathing. I have roughly made that flat statement without particular explanation for the purpose of bringing out all the criticism possible, because I am as anxious to learn the facts about this as you are. I am very thankful to the orthodontists here for the pleasure of having read a paper, and I shall be well repaid and very well satisfied if it shall prove to be of any particular benefit.

I cannot close without offering my profound thanks for the many flattering things said of my paper, even by those who do not agree with me in many respects.

A Comparative Study of Mandibular Protrusion.

By Dr. E. C. Kirk.

I very frequently find myself the victim of the enthusiasm and energy of the chairman of an Executive Committee. Somebody—I have forgotten his name, and I am glad I have, because I do not wish to bear him any ill will—sent me an invitation to read a paper before this body, couched in such terms that it was almost a "stand-and-deliver" order. I hesitated for two reasons. In the first place because I felt my incompetency to bring before this body of learned specialists anything that might interest them, and secondly because of the demands upon my time, which made it impossible to prepare a formal paper. In my desire to accede to the request I turned over in my mind some of the things that might interest this body and finally evolved something which I have entitled "A Comparative Study of Mandibular Protrusion." It is a very beautiful title because it has a high-sounding, sonorous turn to it. It is not a paper. It is a study in the mandibular protrusion from a comparative standpoint, by which I mean that I shall endeavor to present to you some pathological data as it were, and you are to do the studying. I have not as yet come to any conclusion myself in regard to the problem, but there are certain facts and phenomena in connection with this matter of mandibular protrusion which have set me to thinking, and I am bringing my coals to New Castle, not with the idea of disposing of the coals, but with the hope of getting an expert opinion upon the character of the product.

I have about concluded from my study of the Angle classification of malocclusion, and especially of the scientific accuracy of the basis of that classification, that in so far as occlusion is concerned we have nothing else to ask for as a basis of classification. That is, when we deal with malocclusion of the dentures; but there is another feature in this question of dental irregularities, which it seems to me must be taken into consideration, viz.: certain variations which are manifested as irregularities of position of the dental arches, even though the occlusion may be perfect. I want to show you some of the data which I think we must consider before we can reach a classification of irregularities of the dentures which will be comprehensive.

Let me say that for all of the photographs that I shall exhibit, I am indebted to Dr. Cryer; some of them are probably familiar to you, hav-

ing been published in his recent book; nevertheless I want to represent them from the point of view of this study.

I regret that I failed to get the photograph showing the jaws of the skull shown in Fig. 1 in occlusion. You will have to take it as a fact that in the specimen and as is shown in Dr. Cryer's book, so far as the dental arches are concerned, the occlusion of the two dentures is practically normal. The skull is that of a negro, an African cannibal, showing very pronounced prognathism contrasted with the Caucasian. The skull shows

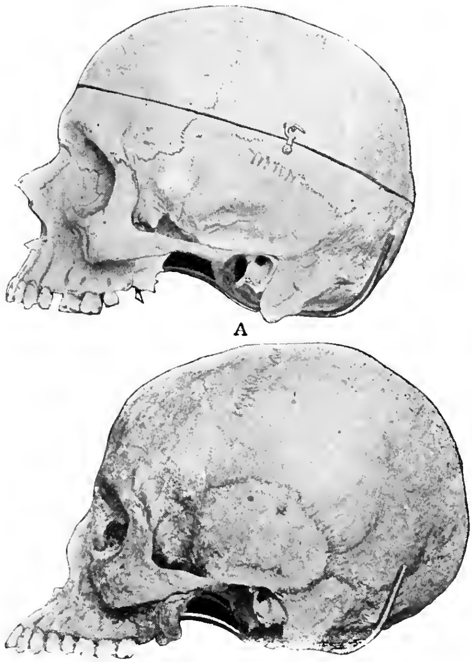


Fig. 1.*

that the dental apparatus as a whole has taken a position forward of what is evident in the Caucasian skull.

In the next specimen, Fig. 2, we have a basilar view of the same crania in comparison and we see very distinctly the moving forward of the dental arches in the African skull. If we take a point in both cases indicated at a line passing through the abutments of the zygomatic arch, you will see that where the line of the arch of the Caucasian skull inter-

*Blocks for Figs. 1, 2 and 3 furnished by courtesy of the *Cosmos*.—Ed.

sects the palatal vault it is between the first molar and second premolar, whereas in the cannibal the point of intersection of the base of the zygomatic arch is between the first and second molars.

This will recall to your minds the remarks made by Dr. Cryer yesterday, on the tendency of the alveolar borders to move forward or backward, but generally forward upon the maxillary or the mandibular bone. It shows that there is a marked difference as Dr. Cryer has already stated, between the maxillary or mandibular base and the alveolar bone superimposed thereon.

We have in the next photograph, Fig. 3, an exhibit of the mandibles of the same crania previously shown and here we see very distinctly that same tendency of the dental arches to travel forward. If you examine

Fig. 2.

the mandible of the Caucasian, Fig. 3 A, you will notice that the third molar is partially hidden back of the ascending ramus of the jaw in the angle formed with the alveolar border, whereas in the negro or cannibal type, Fig. 3 B, with pronounced prognathism, it is very far in advance of that angle.

There is another point on which I desire to lay stress and that is the relation of the mental foramen in these cases to the roots of the teeth. You notice in the Caucasian skull the mental foramen occupies a position between the premolars, whereas in the cannibal it is situated below and fairly between the roots of the first molar. And this brings me to the first point, viz.: that in considering the basis of classification of these irregularities due to forward or backward movement of the dentures as a whole,

if we were to have some fixed anatomical point from which to measure, it would seem that a good starting point would be the mental foramen, because, being a part of the mandible proper, and not a part of the alveolar border, it has a certain definiteness or fixedness of position in reference to the body of the bone which would give us a reasonably constant

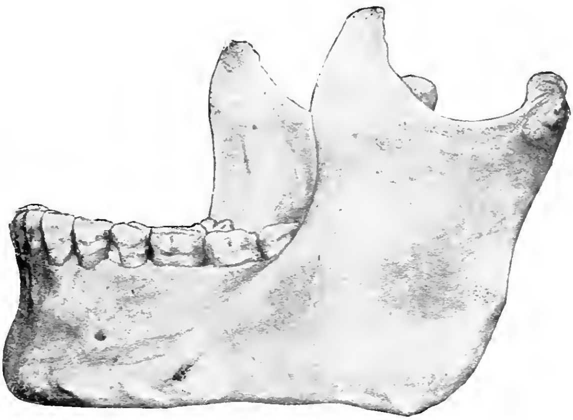


Fig. 3. A.

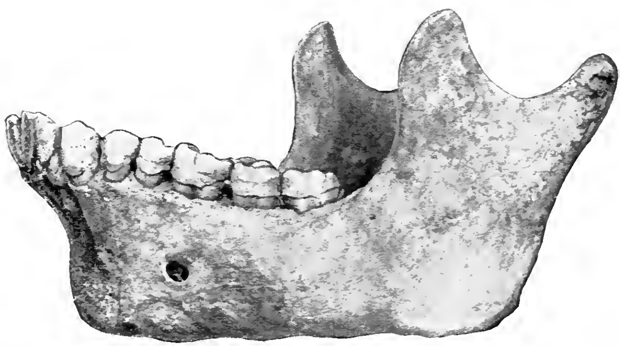


Fig. 111. B.

anatomical point from which to determine the variations in the position of the dentures which characterize prognathism in some of its expressions.

Fixedness of the mental foramen is shown in another way also referred to by Dr. Cryer in speaking of the distribution of the arteries, veins and nerve supply of the anterior teeth when he called your atten-

tion to the recurrent character of the inferior dental canal, showing that the mental foramen was not moved forward in harmony with the development of the alveolar border and it is because of this tendency to fixedness of position that it seems to me to be valuable as a point of anatomical measurement.

As a further study of the relation of the mental foramen to the developing alveolar border, I have a few slides here from Dr. Cryer's col-

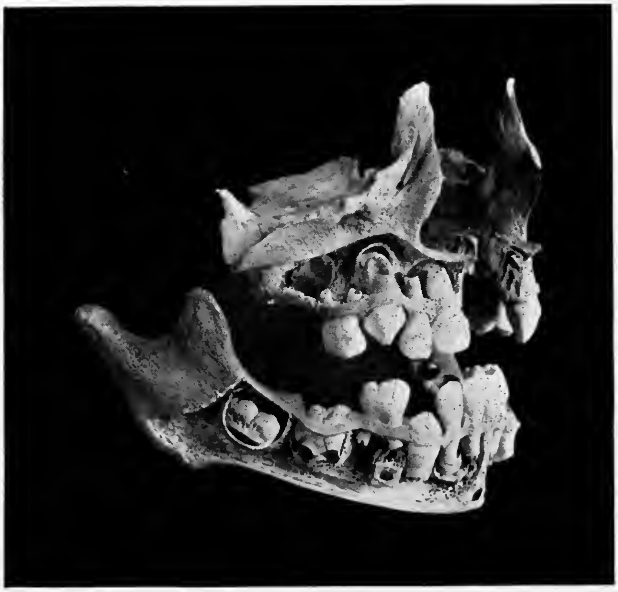


Fig. 4

lection. Here we have the jaws of an infant, Fig. 4, judging from the stage of the eruption of the teeth, probably about eighteen to twenty months old. The cuspids have not erupted in the lower jaw and the second deciduous molar is still almost within its crypt. The child would have the mental foramen situated as it is there shown and for all practical purposes we can say that at that age the mental foramen occupies a position immediately below the mesial root of the first deciduous molar.

In the jaw at the succeeding stage of development a little later, Fig.

5, note the position of the mental foramen with reference to the deciduous denture again. There you see it has tended to take a position posterior to the anterior root; it is now fairly between the roots of the first deciduous molar and immediately under the developing cap of the first premolar and later we find it takes a still farther posterior position.

We have in this later development the mental foramen occupying a position almost under the distal (posterior) root of the first deciduous molar and somewhat back of the developing cap of the first premolar, Fig. 6; and still later we have the mental foramen occupying a position

Fig. 5.

distinctly between the developing premolars of the permanent denture, which is, we may say, its normal position. Fig. 7. There is its practically fixed position in dentures which are in normal occlusion and orthognathous.

It has been shown that in the developing process of the alveolar process it moves slightly forward upon the mandibular basis, which seems to me to be a sufficient warrant for the very definite conclusion drawn by Dr. Cryer and carried out still further from the histological researches of Mr. Hopewell Smith, that the bone of the alveolar border is merely a temporary tissue subject to a certain developmental force

which causes it to change position in the process of development as evidenced by these slides. And we have also seen that there is a fixedness of position with reference to the mental foramen which I think is very evidently marked.

I now want to leave this part of the subject, merely directing your attention again to the suggestion that the relative fixedness of the mental

Fig. 6.

foramen offers, to those studying the subject, a basis of classification of those irregularities of the dental arch which are designated as prognathism, either upper or lower or both, in which latter cases we may have perfect occlusion according to the Angle standard, yet may have facial deformity due to the backward or forward position of both or one of the jaws as measured by the relations of the denture to the position of the mental foramen.

The Jaws of the Bull Dog.

We have a very marked type of mandibular protrusion in the bull dog. The bull dog is an exceedingly interesting beast from a comparative standpoint. In the first place, the bull dog is an animal that has been especially and artificially bred for centuries with reference to certain peculiarities. You all know the remarkable protrusion of the mandible and the arrest of development of the naso-maxillary region. He is an artificial product and because the ideal of perfection in the correct bull dog type has been the creation of specimens having those

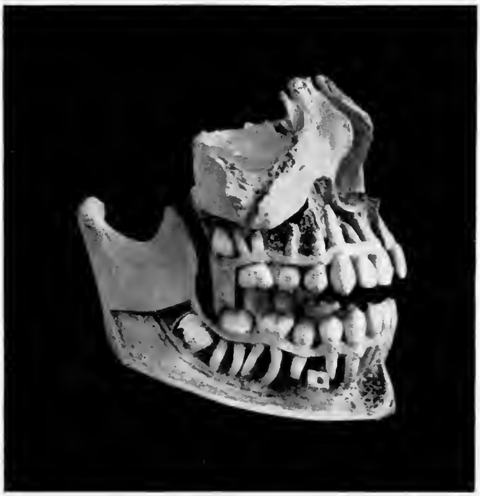


Fig. 7.

marked peculiarities in greatest degree, he is therefore a degenerate; a degenerate that would delight the heart of Eugene Talbot, I am sure. I do not propose to go into a consideration of what it is that has caused the arrest of development of the naso-maxillary region of the bull dog, but there is an arrest of development whatever may be its cause, and there has been artificial production of that peculiarity up to a high degree coincident with an equally marked ratio of degeneracy in other characteristics.

The bull dog is characterized by tremendous courage and pluck. These are his features of which we always think when the animal is mentioned, but from the point of view of efficiency in punishing his ad-

versary, he is essentially defective. He does not have in his dental apparatus that perfection of occlusion which we find in the ordinary type of the *canis familiaris.* The bull dog does not have what fanciers call a "punishing jaw." His method of attack or combat is peculiar to himself. If you have ever seen a dog fight and studied it from a scientific standpoint—and that is the only way I will confess to have studied them at all—you will have noticed that the bull dog's tactics are to take hold of and hang on to and wear out his antagonist. He lays hold of a leg, throat or head and there he hangs and shakes and worries his adversary until he has conquered him. If you notice the fox terrier, you will see

Fig. 8.

that his method of attack is like that of the wolf. He does not hold on to his adversary, but he is continually snapping at him, taking pieces out of him, in the endeavor to tear the flesh to pieces.

I have bred bull dogs for some time for experimental purposes and have studied their habits very carefully. Many times in the small hours of the morning I have heard the dogs fighting in the kennels, and as I had some good specimens which I did not want to have ruined, I would go out and stop the fight, which is very readily done, by the way, by sprinkling some pepper or snuff upon the noses of the contestants, and as they are obliged in the course of nature to stop and sneeze they forget

about the fight. I have several times observed that no matter how long the quarrel continued and how vicious it seemed to be by the sound and struggles, the result was a matter of very small moment to the bull dogs themselves. That is, very little real injury had been inflicted. I have gone out in the morning and found the kennels presenting a ghastly spectacle, but when I afterward examined the physical condition of the dogs, I would find injuries perhaps only skin deep; and the fight being over they would extend the courtesy to one another of licking each others wounds and were friends again until their difficulties were renewed

Fig. 9.

owing to some difference of opinion that could not otherwise be adjusted between them.

The Wolf's Jaws. When we come to study the perfect canine denture I want to show you the timber wolf, *canis latrans.* Fig. 8. It is defective in this specimen because the specimen has been mounted with the jaws apart and the warping caused by drying out has disarranged the occlusion. I will show you in another specimen of the dog a denture in which the occlusion is perfect.

There you see a denture which is of the true carnivorous type, the shearing type. It is highly efficient for the purposes of its environment. It has a shearing motion perfectly adapted to the cutting of flesh.

I show you a naso-maxillary view of the same skull. Fig. 9.

Here you see the anterior occlusion is almost edge to edge. The idea of the shearing action is carried out throughout the whole denture supplemented by the guiding dowel-like action of the canine teeth.

Another and noticeable feature is the relative proportion of the nasal aperture in this skull as compared with the surrounding structures.

Fig. 10.

The nasal aperture is one through which the animal may breathe large quantities of air. He is swift of foot and his respiration is rapid. He is therefore built so that he can take in large quantities of air rapidly.

The Greyhound.

We have another animal in which we have the perfect carnassial denture, the ordinary greyhound. Fig. 10. Here we have a specimen not quite so distorted by the drying-out process. You see the perfect shearlike arrangement of the teeth, the interlocking canines, a typical specimen of the canine jaw, in which there has been no degenerative process at work. We here have the naso-maxillary view of the greyhound, Fig. 11, in which you get a good idea of the relative size of the nasal aperture to the skull as a whole. There is an enormous provision for the rapid in-

spiration of large quantities of air necessary for all animals which travel at high speed.

With these types in mind we will go back to the side view of this skull and call your attention to the occlusion. Fig. 10. There you will see the large carnassial molar in the upper jaw occludes in close relation to the distal portion of the lower corresponding tooth. That would correspond with the first molars according to the Angle classification of the human denture.

Fig. 11.

The Bull Dog.

Now we will take up our degenerate. Having gotten, I hope, a sufficiently clear idea of the type of the normal dog; here we have the degenerate bull dog, Fig. 12. Applying, for the time being, the Angle classification or basis of occlusion here, you see that the large carnassial molar in the upper jaw is almost in normal occlusion so far as its position front and back is concerned, with the corresponding tooth below. Here you see the enormous development of the mandible and above the lack of development of the nasal maxillary region.

The bull dog develops this condition after birth. Of course I do not mean to imply that there is no tendency in this direction during the foetal stage because we cannot doubt the conclusion that this developmental peculiarity begins as far back as the coalescence of the ovule with the

spermatozoid. It is, however, so little marked at birth that the bull dog puppy has an edge-to-edge bite. I have here the head of a bull dog puppy at birth, and also the specimen of the adult skull from which these photographs were taken is here for your inspection. It is quite evident that the mandibular protrusion is a condition of arrest of development of the naso-maxillary region, due, I am almost tempted to say, to a trophic disturbance, but I do not want to go on record for that, as I do not know that the cause has been investigated. We

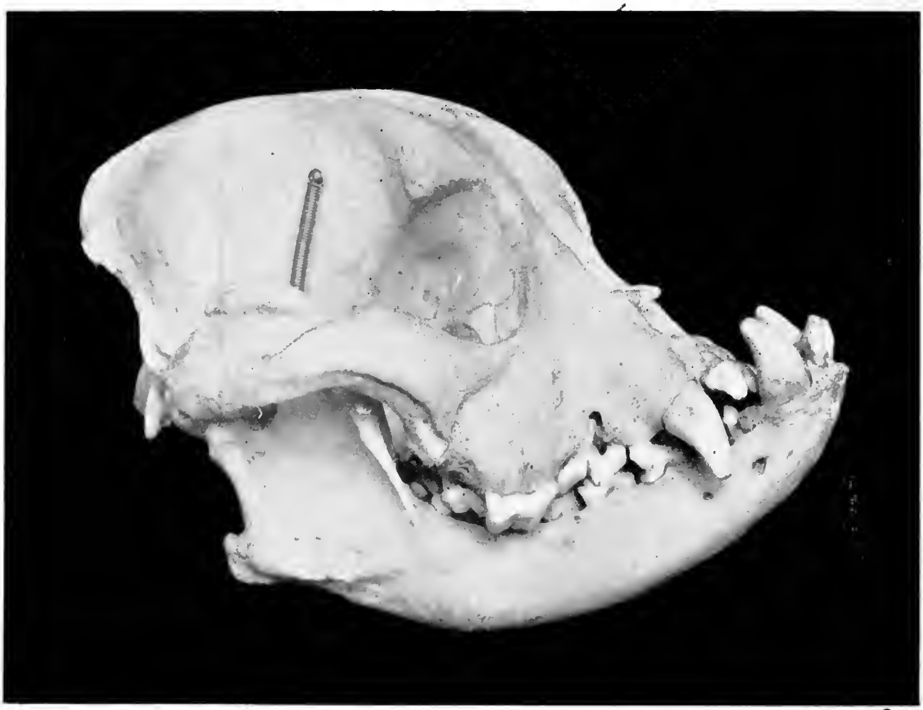


Fig. 12.

do know that as compared with the normal dog we have here a tremendous modification under purely artificial conditions in which natural selection has had no part. It has been done with the greatest care by the fanciers of this sort of animal and they have exercised extreme care to bring it to the condition in which we now see it.

I would call your attention to the upward turn of the lower jaw of the bull dog. The tendency until modified by muscular action is for the

mandible simply to protrude. There are many specimens of the bull dog in which you will find a shovel-like lower jaw protruding without the end upturned. From muscular action, however, the lower jaw, acting against the first carnassial molars constitutes a lever in such relation to the actuating muscles that they act on the forward end of the bone and we have as a result this turning up, the modification being due to the extrinsic effect of the muscular power upon the mandible during its process of

Fig. 13.

development which tends to give it the upward turn so highly prized by the fanciers of this particular breed of dog.

Another point to which I wish to call your attention is the relation between the nasal aperture and the rest of the skull, and to recall to your minds that same relation in the skulls previously shown.

Here we have an anterior, Fig. 13, view and you see a relatively small nasal orifice. I have a suspicion that the bull dog tends to be a mouth breather. He has great difficulty in breathing through his nose,

and with regard to the nasal cavity the bull dog also shows symptoms of degeneracy.

My observation leads me to believe that we have a perfectly analogous condition in the human being, mandibular protrusion due to the arrest of development of the premaxillary and nasal region. There are many other causes of mandibular protrusion which are manifested simply as a sliding forward of the lower jaw in which we have an obtuse angle formed by the ramus and the body of the bone, and cases are found which show perfect dentures when each denture is viewed singly, but it is the relation of the dentures that is out. There the Angle classification applies perfectly; but with the Angle classification in connection with the position of the mental foramen we should be able to separate in our minds the cases of mandibular protrusion of the human being which are simply due to improperly related mandibular arches and those which are the result of some disturbance of the nasal cavity or the development of the structure of the nasal region.

I have a friend here with me this morning who presents a case of mandibular protrusion. His arches are in such condition that I should say the condition in his case was one purely of deformity of the angle formed by the ramus with the body of the bone. I have brought him here for study and the benefit of your opinions.

I have brought this matter to your attention merely as suggestive. I have made an exhibit of the data which have seemed to me to suggest a possible extension of classification of our cases of prognathism, mandibular protrusion, or of premaxillary protrusion, if you choose, which I believe is worth considering. I shall be glad to have your opinion upon it. The specimens I referred to are here on the table for your inspection. The young gentleman mentioned is also here. I shall be very glad to have you look at his case and see whether you agree with me that it is a case of simple malformation of the angle of the jaw and does not necessarily depend upon any defect in development of the naso-maxillary region.

I thank you very much for your attention.

Some one asked if the pronounced peculiarity of the bull dog is not developed gradually subsequent to birth; in other words, does not the bull dog at birth present the same appearance as any other dog?

Dr. Kirk replied:

Yes, sir, so much so that I have on one or two occasions had bull dogs of the feminine gender escape from the kennels and form a mesalliance with some other type of dog, and it has taken three months of development to determine by the appearance of the pups that such had been the case.

Discussion of Dr. Kirk's Paper.

Dr. Cryer. I have nothing to say except to speak of the shape of the heads at birth. I have raised bull dogs and greyhounds and perhaps a dozen other varieties, even to the miserable little pug,—another degenerate in the head. After the dog is born, if it is a greyhound, the face will elongate after the trait of its ancestors. If it is a bull dog, the upper jaw will be lacking in development.

Dr. Angle. In this phase of comparative anatomy Dr. Kirk has introduced an exceedingly interesting subject—a sidelight to orthodontia. Comparative anatomy, I have long believed, is the very basis of all dentistry, and especially of orthodontia, for it is only through a comparative study of the teeth of animals that we can learn of the occlusion of the teeth of man, and the many phases that lead up to their normal and abnormal arrangements.

I believe that if we could be present at a meeting of this Society twenty-five years from now we would find the orthodontists of that day very familiar with the subject of comparative dental anatomy, and that they had profited mightily from this knowledge.

Dr. Kirk's suggestion of using the mental foramen as a point from which to judge, or at least to assist in judging, the relations and proportions of the jaws and dental apparatus to the skull may be a valuable one. To determine some fixed point or line to enable us to judge the extent of the normal and the abnormal has long been a perplexing problem to the artist, the craniologist and the orthodontist. Personally, I do not believe there is a better tangible point than the upper first molar, and taking it for granted that this is right, move the lower jaw backward or forward to be in harmony therewith. But it is quite probable that the upper arch is rarely exactly where it should be. We know that one eye is seldom on a perfect level with the other, and that the lateral halves of the body are different. We therefore have no reason to think that the upper dental arch is more often relatively correctly placed. Yet believing, as I have said, the first molar to be the nearest to a normal fixed point I have selected it as a basis for the classification of malocclusion. But Dr. Kirk's most interesting and excellent paper should furnish us with much to think about. And if it can assist us to better understanding of what is normal and what is abnormal, it will be most valuable to us as orthodontists.

Dr. Kirk. I came here for information. There is in my belief, a very great distinction to be made between those cases of mandibular protrusion which are due, first, to an arrest of development of the naso-maxillary region, such as is shown very definitely in the case of the bull dog, and that other classification, or class of cases in which there is a protrusion forward of the mandible due to the difference of the angle. The whole question of the correction of facial deformities is bound up in this question. I was looking to the President to specifically take hold of the matter, and in order that he may do so I present this young friend of mine. You will appreciate the scientific interest he has in the matter to come here and serve as critical material for our discussion. I shall ask you to look at him from that point of view.

I think this subject has an important bearing on the question of whether we shall or shall not extract. I have seen many cases of correction of irregularities of the teeth where extraction has been resorted to where I regard it as simply malpractice, from the standpoint of utility; but simply a cosmetic operation had been done.

These are questions, it seems to me, to be bound up intimately in the study of these two classes of cases.

(Dr. Kirk then called the young man forward and asked Dr. Angle: What would you do with this case?)

Dr. Angle stated that before passing judgment upon the proper treatment for the case submitted, he desired to make an examination.

While making the examination, Dr. Brady spoke as follows:

Dr. Wm. J. Brady. Some time ago my attention was directed towards this very class of cases to which Dr. Kirk has brought our attention. I have found that the development of the upper and lower jaws are practically independent of each other. There are certain causes which affect the development of the lower, which seem to have no influence upon the upper, and *vice versa.*

Now, one possible reason is that in the upper jaw, all the bones of the face articulate with each other in some manner; the development of one largely stimulates the development of another, in fact the same forces that create development of one create development of all of them, and in that way they are intimately connected. But the lower jaw is not thus attached to any of the bones of the face, and its nerve supply and blood supply are also disconnected. It seems to be a law unto itself so far as development is concerned. We have had considerable talk about the development or non-development of the upper on account of mouth breathing, but nothing has ever been said about the causes of

this peculiar development of the lower. The example before us I would call perversion of development. There is, as we know, a certain type of lower jaw which we may call normal or usual. I will ask Dr. Lourie if he will be kind enough to step out and give us a side view of his head, and we will see what the ordinary kind is. (Dr. Lourie responded as did also others who were afterwards called upon by Dr. Brady.) It has the usual square ramus, a squarely developed body, a type with which you are all familiar. Another illustration of this kind is our friend here, Dr. Summa. If he did not have so much good St. Louis meat over his jaw you could see the same thing. If Dr. Barnes will step up we will use him as a "horrible example." Now, here is a tendency toward development in another direction that is marked by two things, lack of angle of the jaw and protrusion of the chin, of which we have several other examples here in the room.

(The doctor called upon a number of others, commenting upon the formation of the parts of the face under consideration.)

If you will look about the room you will find that there are intermediate variations from the square angle of the jaw, from a very little on up to the condition as bad as shown in the case before us.

Now, what are the causes? I have determined several influences that seem to operate to cause perversion of development, but they all act through a central channel; that is, some disturbance of the nervous function that affects the development; one cause at one time, another at another time seems to produce the same result.

This perversion of development sometimes takes another form in which there is a continued growth of jaw. There seems to be a center of growth somewhere near the region of the bicuspid, and at about the age of 16 or 17 it seems to actively begin work and starts to grow bone. I have had an opportunity to examine some four cases of this kind and in all of them I find they began about the 16th to 18th year, and the bone continued to grow up to twenty-five years or so. The growth is not always confined, however, to the region of the bicuspid, although it usually is. I have a model of a case in which the growth is behind the teeth, yet is continuous and has progressed in the last five years something over half an inch.

What Dr. Kirk has given us is in line with this; but what are the causes of these peculiarities is something for us to study upon long and faithfully. We need a fixed point, as Dr. Kirk has brought out in order to determine when the jaws are in normal position.

I hope next year to be able to show a number of cases of this kind, with photographs of the patients.

Dr. Angle. It is already past closing time, but as Dr. Kirk has kindly brought his patient here that we may all be mutually benefited by a consideration of this very pronounced case of malocclusion, I will hastily give my opinion and then ask to be excused as I have pledged myself to begin my paper promptly at two p. m., and must prepare for it.

The patient possesses one of the most pronounced cases of malocclusion I have ever seen. As you see, it belongs to the third class, or what is commonly known as protrusion of the mandible. I must frankly confess to you that I know really but little that is of value in regard to this whole class of cases; neither do I believe there is much known concerning them or their causes. They are shrouded in much mystery. I have observed, however, in every case tending toward this class that has come to me for treatment where the patients were young, that they were sufferers from enlarged tonsils. I do not know whether or not there is any relation existing between these conditions, but I often think that possibly there may be.

I have never seen a case of this class that seemed to be inherited. Neither do I believe they are degenerates, and I believe it is as cruel as it is ignorant to stamp them as such. Both physically and mentally I believe they will average with the rest of humanity.

The best article yet contributed on this subject was written by a layman, and published in the *Western Dental Journal,* entitled "Jimber Jaw," in the year 1897.

I believe there are no cases of malocclusion so markedly progressive as those belonging to this class. Hence the importance of early and prompt attention being given to them. The cases that I have been most successful with were those that I began early—at seven, eight or nine years of age—shifting and locking the first molars in normal relations, and compelling the latter when the jaws were closed, by spurs closing *behind* metal planes, these planes being soldered to bands on the upper molars and the spurs being attached to bands on the lower molars, as familiar to all of you who have read that portion of my book bearing upon molar retention. The tendency of this treatment is to stimulate the growth of and push forward the upper jaw and retard the movement forward of the lower—the tendency so pronounced in all these cases. And yet when the overdevelopment of the mandible has progressed to the extent shown in this young man's case, I feel almost powerless to suggest anything of much practical value.

Some nine or ten years ago it occurred to me that in such pronounced cases the jaw might be successfully shortened and the occlusion improved or perfected by double resection of the jaw, and I discussed the

plan freely with surgeons and dentists. Within the past four years two cases have been so treated, one resulting sucessfully, and the other being a complete failure. The latter operation was performed in New Orleans. However, I do not think this failure should reflect against the operation if properly performed. In the case resulting in failure the operation was as badly performed as could well be imagined. In fact, after the third or fourth day no effort was made to hold the segments in apposition, the result being, as might be expected, almost the complete loss of the jaw by necrosis. The sections in this case were made, unfortunately, at the angle of the jaw.

I believe the time will come when this operation will be of common occurrence, and recognized as one of the permanent, standard operations of surgery, and one conferring most pronounced benefits, but it can never be a successful operation by the reckless, ambitious experimenter.

It is the utmost folly to attempt the correction of such pronounced cases by means of chin cap and headgear. We may possibly, however, thanks to the Baker anchorage, improve the occlusion slightly in a case like this, but even the maximum of tooth movement could not possibly restore the teeth in this case to normal occlusion. A case like this has progressed beyond what might be regarded as merely malocclusion, and is rather in the realm of a pronounced bone deformity, and, it seems to me, should be treated accordingly.

Dr. Kirk.

I want to express my appreciation of what has been said. I do not feel altogether sure that the talk of Dr. Angle quite covered it. I was very profoundly impressed on one occasion when I was superintending the making of a portrait, in which I was endeavoring to bring out certain points. I would say, Please make that place a little lighter, here, producing high light here and raising the color one or two grades, will do what I want. The man invariably did produce that effect, by putting in a little darker shade below it, never putting in a higher color. It may or may not be true, but while Dr. Angle was speaking I had in mind that experience, and the question occurred to my mind as to whether what he has called a failure or arrest of development in that nasal region might not be an optical illusion. As I view the case I cannot see that there is over-development of the mandible but rather a faulty development of the mandibular angle.

I want to say in reference to Dr. Brady's statement, that we are to explain the degeneracy or arrest of development as due to neurosis of some sort. I think that is very dangerous ground. It may be true, I do not say it is not, but I think we are not in a position to say it is true.

If it is failure of nutrition, it is just as fair to say that it is due to the fact that this young man has not eaten some particular kind of food.

That impression was made at the time of the coalescence of the ovule and spermatozoid of the male and female elements that resulted in the independent organism. That this is true is demonstrated by the fact that I can make that impression on the greyhound by breeding into the bull dog. What it is I do not know. I am reminded of the case of Mrs. Partington who went to the family physician and said, "Won't you tell me why it is that so many people are born deaf and dumb?" And he said, "It is simply because they are brought into the world deprived of the power of speech and hearing," and she said, "My! what it is to have a physical education! Why, I've asked my old man about that thing many a time and all I could get out of him was 'kase they is.'" I do not think that saying it is neurosis, explains the case. It is true there is failure of potential of some sort, but that that is the proximate cause I do not think we are in a position to say. It is something farther back than that, probably something connected with the original protoplasmic impression.

Dr. Brady. I wanted to convey the idea that whatever the ultimate cause may be, it operates through this one point, the disturbance of the nerve function. I don't go farther back than that. Whatever the cause may be, it operates through that point and that is as far back as we can safely go.

Dr. Kirk. Degeneracy is not ever a cause of anything, but it is a result. What I wish to bring out and record is my belief that we are not yet in a position to say just what is the cause of the arrest of development; or in other terms, the failure of the nasal maxillary region to develop in these cases.

Normal and Pathological Anatomy of the Alveolar Process and Adjacent Tissue.

By M. H. Cryer, M.D., D.D.S.

Mr. President and Gentlemen:—It affords me great pleasure to have this opportunity of giving you an informal and illustrated talk upon the Normal and Pathological Anatomy of the Alveolar Process and Adjacent Tissue, with some of the causes for malformation of the mouth, tongue and alveolar process.

The subject may be divided into four parts. First, the bony tissue forming the jaws and alveolar processes.

The first four illustrations are taken from an almost typical skull. The object of giving these illustrations is to show what may be considered the typical arrangement of the teeth as to position in the alveolar process and their relation with each other in the individual jaws, as well as in the upper and lower jaws. There is a slight deviation in the nasal septum which is sometimes accompanied by a difference in the shape of the maxillary bones. It will not do to lay the cause of this difference or the position of the teeth to a crooked septum. The same cause which produced the deflected septum would more than likely influence other deformities of the maxillary bones and the position of the teeth.

Dr. Kohler said in his paper yesterday that the Rhinologists find that nearly all persons have crooked or deflected septa of the nose. No doubt with but few exceptions those examined by the rhinologist have deflected septa, for it must be remembered that those having straight septa seldom, if ever, visit the rhinologist. In examining the skulls that have been cut transversely through the nasal fossae, I find the greater percentage have straight septa. Even when the septum is deflected that portion composed of the vomer is seldom involved. He also spoke as though the septum could be forced upward in such a manner that the brain might be injured. If the general architectural features of the hard tissue were studied, it would show that it would be impossible for a thin cartilaginous septum to force the ethmoid bone upward.

There has been considerable discussion in regard to "jumping the bite" or the movement of the mandible forward or backward the width of a premolar tooth. This will greatly depend upon the indi-

vidual. In some cases the mandible could be carried forward, but the anatomical structures of the articulation would make it almost impossible to carry it backward. There are three skulls in the working museum of the Dental Department of the University of Pennsylvania where the condyloid process has been carried forward, the eminentia articularis and the head of the condyle having been so flat-

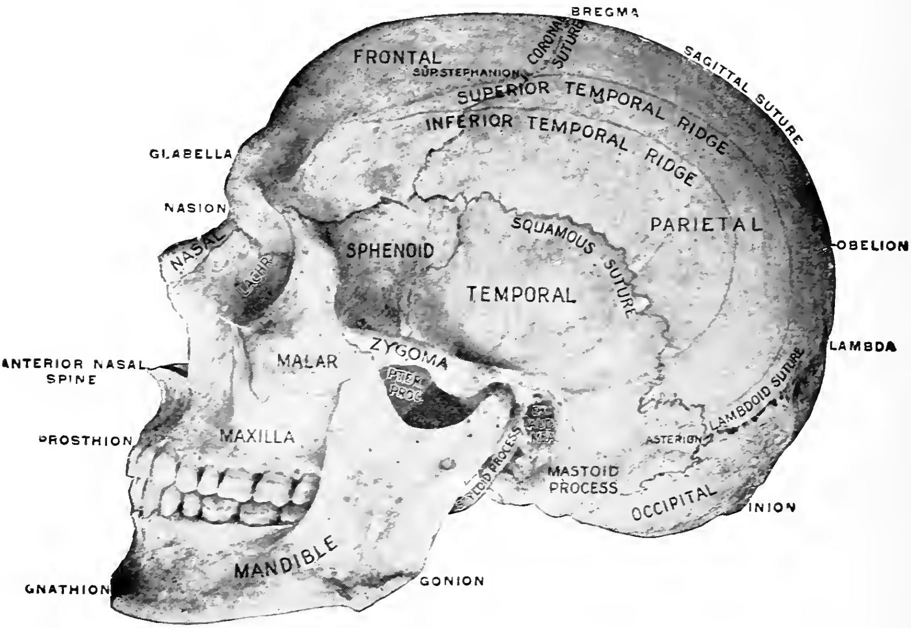


Fig. 1.* Side view of a typical skull.

tened that an articulation has been found in front of the glenoid fossa. Fig. 5 is taken from one of these specimens.

Dr. Kohler spoke of the teeth as belonging to the maxillary bone. This is a generally accepted term, though they really do not belong to these bones. Teeth are dermoid appendages developed from the mucous membrane of the mouth and are situated in the alveolar process which is attached to the bone. This bony tissue of the alveolar process differs in many ways from the bony tissue of the body. Dr. Hopewell-Smith in his microscopical studies has shown that the

*Figs 1 to 14, inclusive (except Fig. 2), are from Dr. Cryer's book, "Studies of the Internal Anatomy of the Face," and the blocks are loaned by the publishers. All the other illustrations are from hitherto unpublished photographs by the author.—Editor.

Fig. 2.

Fig. 3. Anterior view of the typical skull shown in Figs. 1 and 3.

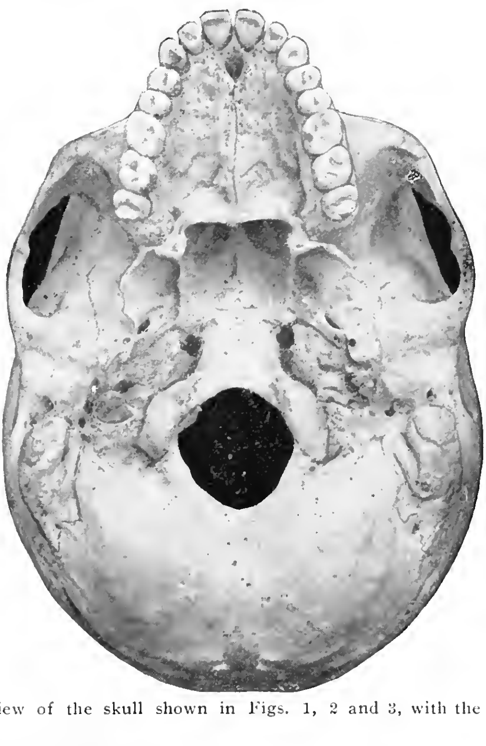


Fig. 4. Under view of the skull shown in Figs. 1, 2 and 3, with the mandible removed.

bone of the alveolar process is different histologically: in the Haversion system especially. The process is developed with the teeth and is lost with them. Surgically the alveolar process acts quite differently. It may be well to cite a case for illustration, of a patient who had lost, by necrosis, all of the bone between the first premolar and the second molar of the left side of the mandible. Complete bony separation of the parts had taken place. A splint or "bridge" was made which extended from the third molar on the affected side over

Fig. 5.

Modification of the left temporo-mandibula, articulation through the jaw being forced forward in mastication in order to bring the remaining teeth in occlusion.

the separation to the anterior teeth and the premolars on the right side. This was cemented into position on the first day of June, 1899, and was removed in January, 1900. The bone belonging to the mandible proper had reformed, uniting the two portions. The outer, inner and under surfaces were so smooth that the place of separation could not be seen or felt. On the top of the bone, however, there was a deep depression where the alveolar process had not been reformed, showing a marked difference between the two structures.

Fig. 6 is from the skull of an infant at birth. It is quite symmetrical as to the nasal fossæ, the small maxillary sinuses, the germs of the deciduous teeth and the alveolar process of both jaws. It will be plainly seen that the width of the upper jaw is less than that of the lower.

As the teeth grow the alveolar process also increases and extends outward and downward. As the lower jaw increases in width its

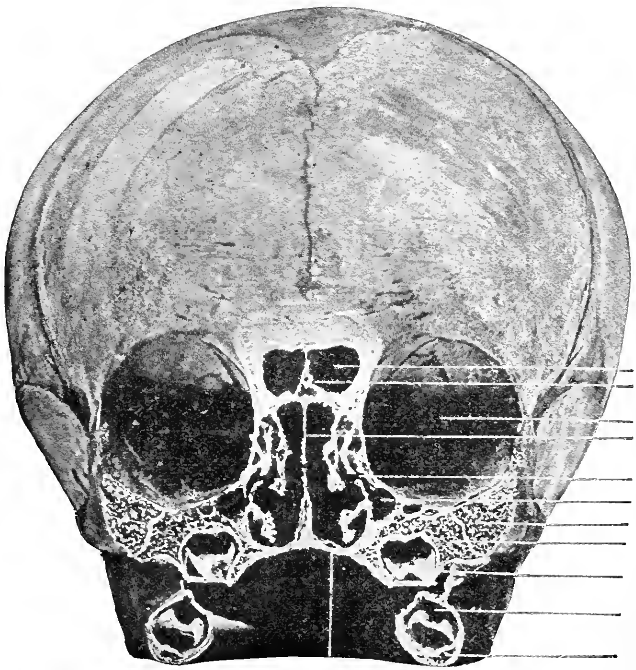


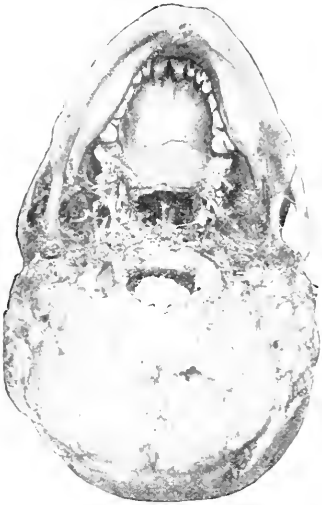
Fig. 6.

Skull of a fully developed embryo, cut vertically through deciduous premolars.

alveolar process extends upward and slightly inward. In this way the lower teeth are found to be in a smaller circle than the upper ones, though the circumference of the lower jaw proper is much larger than that of the upper.

Fig. 7. In this illustration there are two skulls; one about twenty-five years of age with all the teeth in position and we find the lower teeth leaning inward, while the upper ones lean outward. It is the alveolar process and not the maxillary bone that causes this. When

irregularities are corrected the alveolar process is moved and not the maxillary bone proper. The other skull is an old one. The teeth in both jaws have been lost and the alveolar process has been re-



A. B.

Fig. 7.

Under view of two skulls; A, from a subject about twenty-five years old; B, from one well advanced in years.

A. B.

Fig. 8.

Side view of the two skulls shown in Fig. 7.

sorbed in both jaws. The outer plate of the upper jaw is more nearly resorbed than the inner plate, but eventually both the plates and the alveolar process become entirely lost. In the lower jaw the outer

and inner plates are resorbed about equally. During the original development the alveolar process of the upper jaw extends outward and downward, and when it is lost the resorption of the under surface of the upper jaw is very slight, as will be seen in the following illustration. Fig. 8. In the lower jaw the process extends upward and the body of the jaw extends outward so that when the process becomes lost in old age, the mandible is very much larger than the upper jaw. It is for this reason that where artificial teeth are not worn in old age the lips are drawn inward and the chin protrudes forward, and if the mandible is carried upward it overlaps the upper jaw. The angle

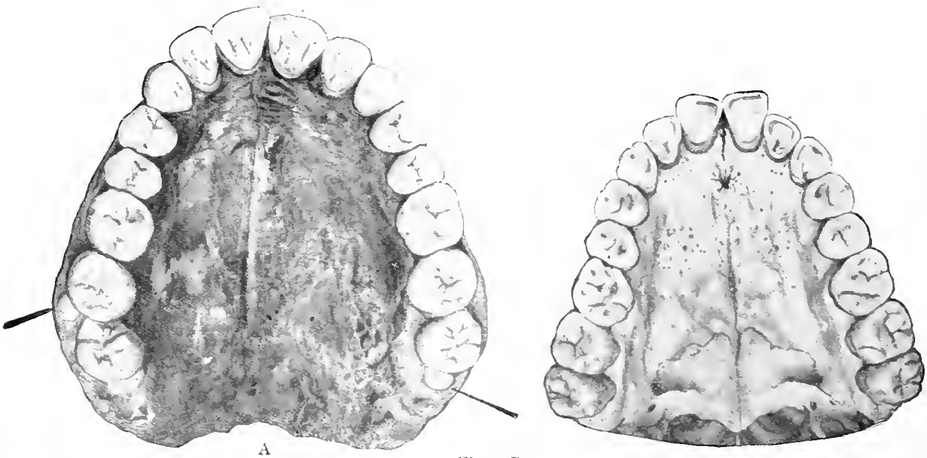


Fig. 9B.

View of the two upper jaws, the occluding surfaces of the teeth and roofs of the mouths, and the great difference in relative size, are well shown; A has two rudimentary fourth molars.

has become obtuse, but if artificial teeth of the proper length be worn, the angle will not change so much.

Fig. 9 is made from two different skulls photographed on the same plate giving their relative sizes. The larger one (A) is enormous while the smaller one (B) is of about ordinary size. If Dr. Kohler were correct in saying that the size of the bones is diminishing, it would be justifiable to say that the larger skull was one that belonged to the past ages, while the smaller one was of the present. But they both lived at the same time and were dissected in the same room.

Close observation of the ancient and modern skulls will demonstrate that the bones of the face and mouth are not deteriorating.

The larger mouth here shown is from a skull much greater in size than can be found in the Egyptian collection of the Museum of Natural Sciences, and I am almost ready to assert that you will not find a skull as large as this one in any collection of ancient skulls. I hope Dr. Grevers, of Amsterdam, who is with us today and who has

Fig. 10.

Anterior lateral view of upper and lower jaws, with the external cortical portion of bone covering the roots of the teeth removed, exposing the cancellated tissue, the roots, and the cribriform tube.

measured more skulls scientifically than any man I know of, will measure this skull and see if he can find a larger one in his researches in the different collections of old skulls. This is a recent skull. The man died about eighteen months ago, and there are other large jaws in the same collection from which this was taken.

It has been asserted by many prominent dentists that the third

molar is deteriorating. I have examined many Egyptian skulls and find that the third molar is quite as large now as it was in the Egyptians. In some of the Egyptian skulls I find a little tooth like the one shown in A, Fig. 9, representing a rudimentary fourth molar. In A, Fig. 9, there are two rudimentary fourth molars, and I have seen many skulls dissected lately which had the same number. Therefore, I claim that the teeth are not deteriorating. Dentists seem to think that teeth are deteriorating because of the defective ones they

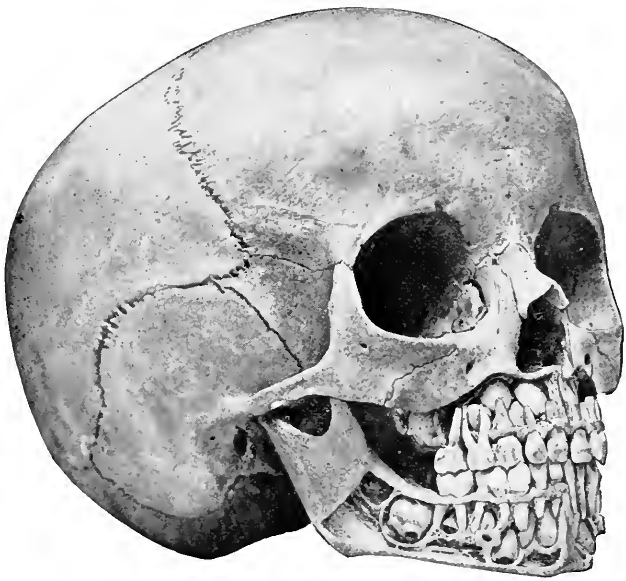


Fig. 11.

Skull of a child about six years old, showing all the deciduous teeth in position and the developing permanent teeth.

treat. There are thousands of people in every large city who never visit a dentist because they have perfect teeth and perfect arches.

Dr. Summa asked: We see in the infant skull, before all the teeth are in position that the angle of the mandible is obtuse, then in adult life it becomes almost a right angle, when in old age it again becomes obtuse: How do you account for the latter?

Dr. Cryer: I believe it is on account of the wearing down of the teeth, and in the endeavor to get the teeth together the mandible is carried upward and consequently forward. In these cases, as a

rule, if you will open the jaw slightly, you will find the lower teeth are back of the normal occlusion. If the teeth are lost at the age of 24 or 30 and artificial ones of proper length are inserted, and renewed

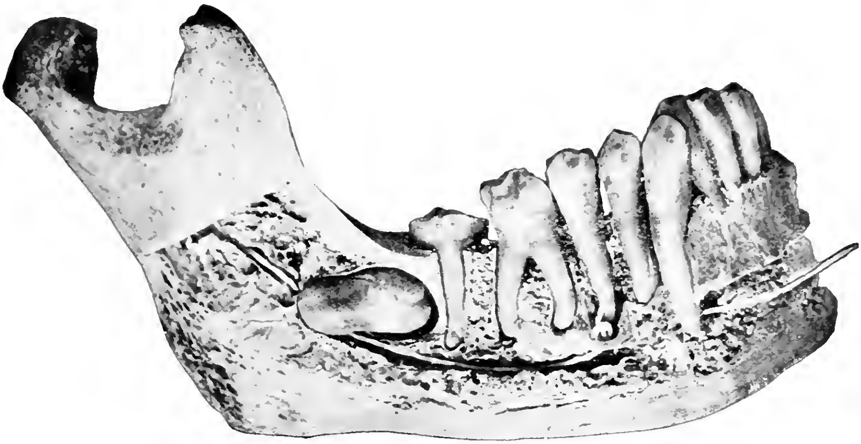


Fig. 12A.

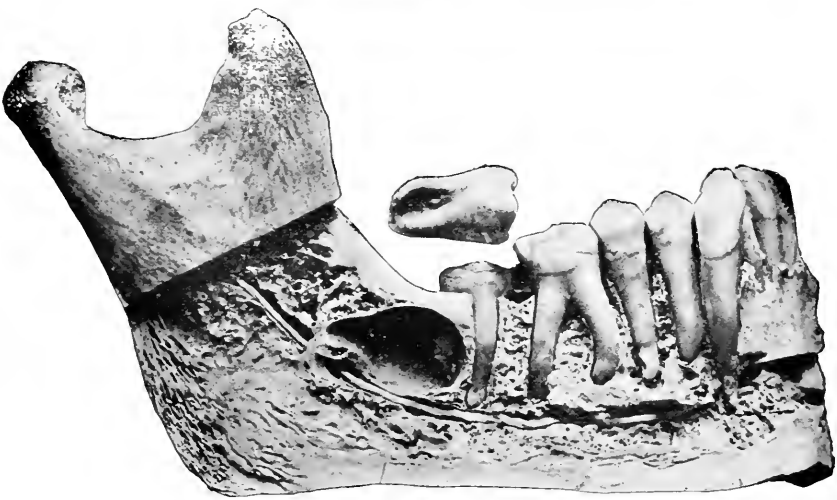


Fig. 12B.

Two views of an impacted lower third molar. In position in A; in B the tooth is turned out of its pocket. Part of the distal root of the second molar has been resorbed exposing the root canal, more than causing the devitalization of the tooth, and thus producing neuralgia, induced by the pressure from the impacted tooth.

as fast as they wear down, there will be but little change in the angle. In one case I found a cadaver of an old person that had been wearing artificial teeth and the angle was as acute as in a person of forty years.

Fig. 10 is made from a skull where the external plate and a portion of the bone underlying it has been removed, exposing the cancellated tissue of the alveolar process of both jaws. Just above the second molar tooth the true maxilla has been cut away exposing the maxillary sinus showing the thinness of the walls. The cancellated tissue of the alveolar process is well shown between the roots of the teeth. In the lower jaw the arrangement of the cancellated tissue is in a curvature, trabeculæ passing from the base upward and forward in a line of the former passage of the teeth as may come forward and upward in their eruption. Near the center of the ramus or at the inferior dental foramen the cribriform tube, generally known as the inferior dental canal, passes downward and curves forward to near the incisor teeth. Just anterior to the canine teeth it usually sends back a recurrent tube with its exit through the mental foramen. The tube is cribriform (sieve-like) in character, and is the passageway for the nerves and vessels going to the roots of the various teeth as well as the general cancellated tissue.

Fig. 11 is made from a skull of about six years of age.

All of the deciduous teeth are in position and the developing ones in view, except the third molar of the lower jaw and the second and third molars of the upper jaw. The germs of the second and third molars of the lower jaw are in the ramus. As the teeth develop they pass down from the ramus and forward to take their proper positions in the mandible; they naturally go in a somewhat curved direction as shown in the last illustration. It will be seen that all the permanent teeth are more or less encased in bony tissue or capsules belonging to the alveolar process, which at this time is in a stage of great growth. The osteoblasts are active. If they should become over stimulated by the extra flow of blood brought to the parts by irritation, it is possible that an over amount of bony tissue would be built around the tooth organs, or it might become more dense than it should be. In such case the capsules of the teeth may become attached to the bony wall or cortical portion of the true bone, and thus be prevented from obtaining their normal position in the jaw. This is one of the causes for impacted teeth, or why they erupt in abnormal positions. In fact it is one of the causes of malformation of the mouth.

Some of the causes that bring about this inflammatory condition and cause the over production of bone tissue about the tooth germs, may be constitutional, such as syphilis, scarlet fever, etc. When the cause is local as from diseased deciduous teeth, after they remain in the mouth too long, the proper eruption of the permanent teeth will not take place. There may be a good reason for not extracting, but

much worse results will follow by allowing the irritation to remain in the mouth.

Suppose a deciduous tooth were to become diseased, the surrounding

Fig. 13A.

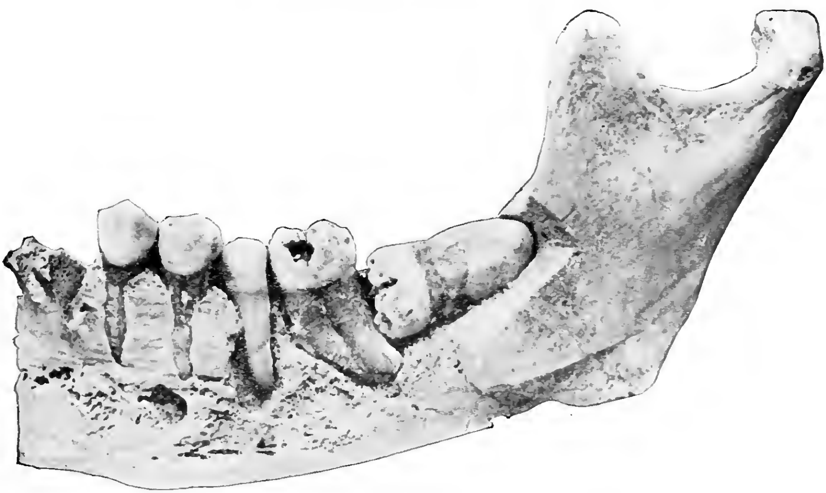


Fig. 13B.

An impacted lower third molar and a lower third molar, with curved and thickened roots, both belonging to the same jaw. The bone is much more compact than normal bone.

tissue would be inflamed and the osteoblasts belonging to that region becoming over active and multiplying in great numbers, would build the bone in such a manner that the cancellated tissue would become more com-

pact and be of a less yielding nature; even the cortical bone would become harder. This would have a tendency to retard the eruption of the tooth, or if it be an upper one it might be erupted into the antrum, nasal chamber, or the roof of the mouth. Dr. Grevers has some photographs where two canines have been turned upside down, the cutting edges in the direction of the orbits. There are many similar specimens in the collection from which these illustrations were made. These conditions are brought about by neglecting the deciduous teeth in childhood. Inflamed conditions should not be allowed to remain in or about the jaws, and teeth that cannot be prevented from causing inflammatory conditions should be extracted, although you know the trouble caused by the early loss of these teeth.

When inflammatory conditions have existed in or about this tissue for a time, a great change takes place. Figs. 12 a and b, 13 a and b, and 14, will fully demonstrate this fact. The first one, Fig. 12, shows where a third molar has been impacted lying horizontally with its occluding surface resting against the roots of the second molar. The impacted tooth may not have been the original cause of the irritation, as there was a cause for the impaction, but in later years it must have been a factor which produced a certain amount of irritation. The distal root of the second molar has been resorbed until the pulp canal is exposed, thus causing the devitalization of the molar tooth. The bone around the other roots is not cancellated as is shown in the normal specimen, but the spaces between the trabeculæ have become filled and the cancellated bones is more dense, almost like cortical bone.

Fig. 13 is an illustration of where another impacted tooth is associated with a much more dense bone than the illustration just passed.

Fig. 14. The third illustration of this character is taken from a specimen of the lower jaw, cut transversely at the mental foramen. On one side the cortical bone and the cancellated tissue is normal in character. Teeth could be easily moved forward, inward, outward, or backward. Extraction would also be easy as the tissue is elastic. On the other side the bone is dense and the character of the cancellated tissue is comparatively changed. It would be almost impossible to change the position of the teeth in such a jaw, and the extraction of the teeth would also be difficult as they would be liable to break. As the nerve tubes or canals are encroached upon, neuralgia

would be liable to take place in this jaw. The reason for this condition is that the first molar was diseased and allowed to remain as a constant irritant, inducing more blood to the parts and producing over activity of the osteoblasts, etc.

The following illustrations have been made from specimens that were so prepared that the tissue is shown in as nearly normal a condition as possible. The preparations are made in the following man-

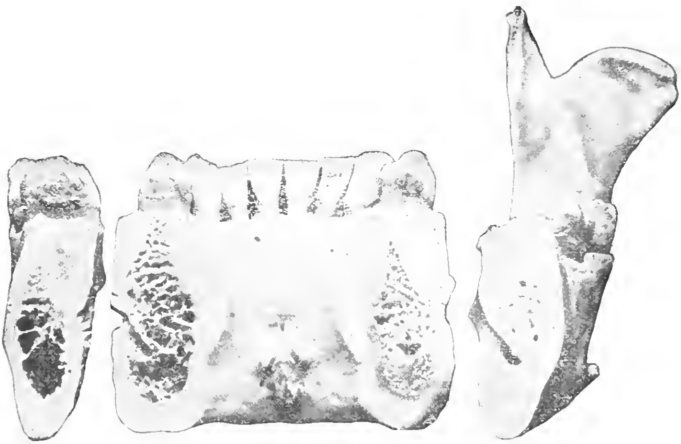


Fig. 14.

Transverse division of a mandible at the mental foramen. The left side is in an almost normal condition, while on the right side the cortical bone thickened and becomes dense, and the cancellated tissue has become filled with secondary bone deposit.

ner: the cadaver is injected as soon after death as convenient, with a solution of formalin, then again with a solution of colored plaster of Paris. The body is covered with vaseline and then bandaged in order to prevent evaporation. It is then placed in a cold storage room at about 15 degrees Fahrenheit. When thoroughly frozen it is ready for sectionizing, which is done with a thin bladed saw with chisel-shaped teeth. In this way the finest bones can be cut without breakage and the brain tissue without displacement.

Fig. 15 is an illustration made from a section that is cut horizontally just above the mylo-hyoid muscle, and is a view looking upward at the base of the tongue, giving a better idea of the true anatomy of this region than would be obtained by the old manner of dissecting. There is not time to go into the general anatomy of the parts.

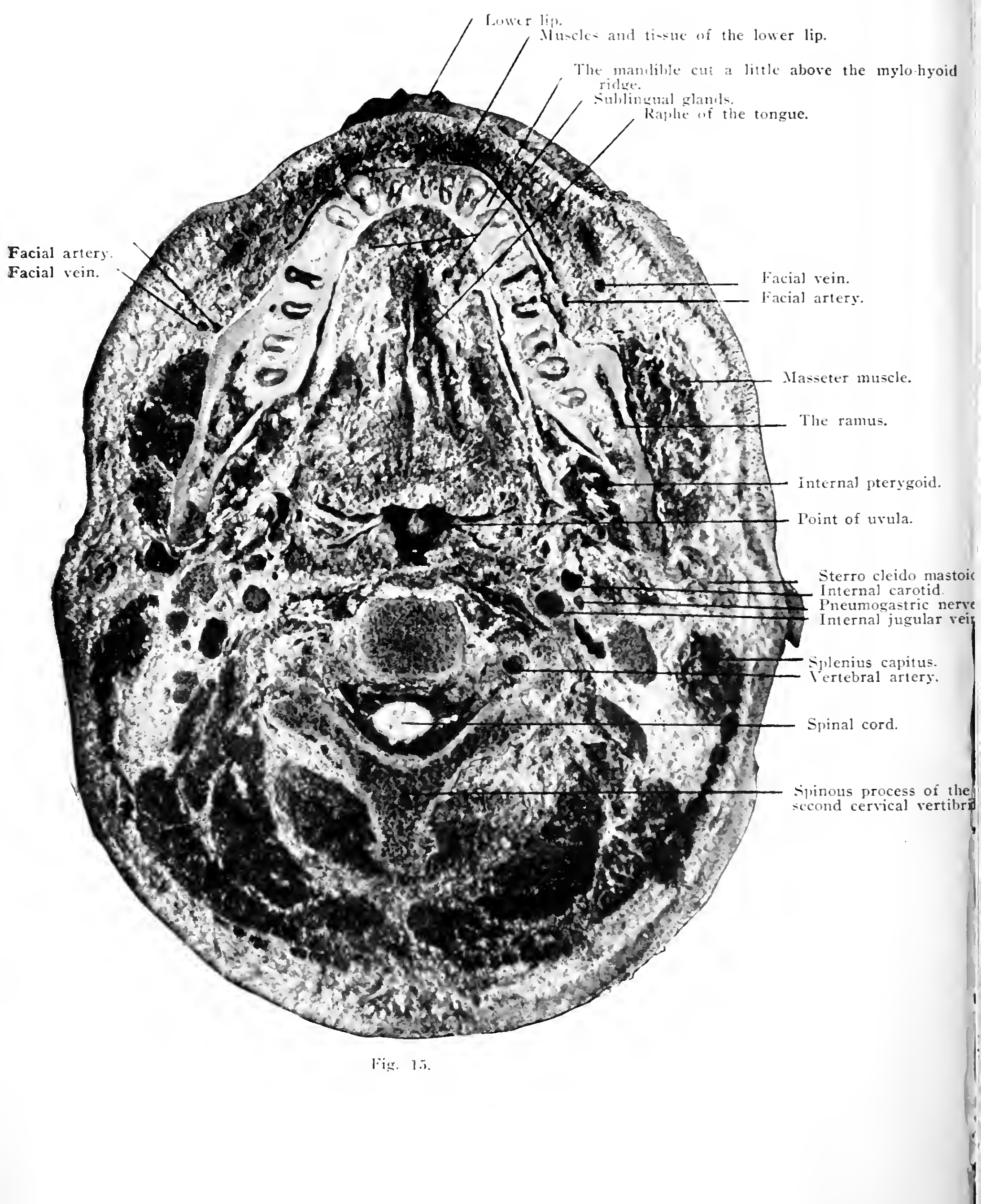

Lower lip.
Muscles and tissue of the lower lip.
The mandible cut a little above the mylo-hyoid ridge.
Sublingual glands.
Raphe of the tongue.
Facial artery.
Facial vein.
Facial vein.
Facial artery.
Masseter muscle.
The ramus.
Internal pterygoid.
Point of uvula.
Sterro cleido mastoic
Internal carotid.
Pneumogastric nerve
Internal jugular vei
Splenius capitus.
Vertebral artery.
Spinal cord.
Spinous process of the
second cervical vertibr

Fig. 15.

Fig. 16 is an illustration made from a horizontal section cut above the roots of the upper teeth, exposing the maxillary sinuses, the nasal fossæ, and the under surfaces of the turbinate bones along with other important anatomy of the face, such as the cross sections of some of the muscles of mastication and those associated with the soft palate.

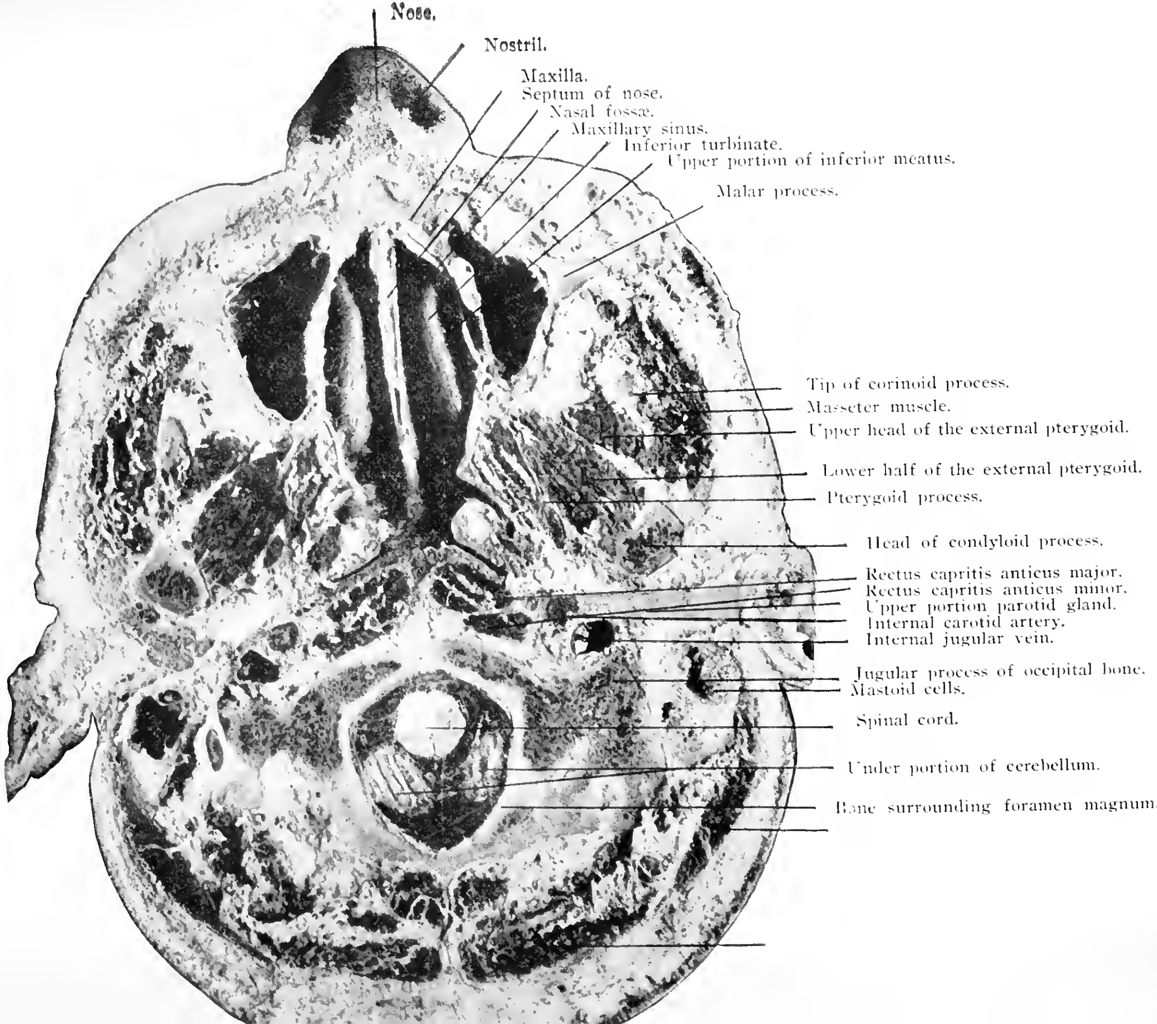
Fig. 17 is an illustration of a horizontal section cut on a level with the upper part of the nasal fossæ and the middle of the orbits. It gives a good idea of the convolutions and other anatomical features of the brain, the ethmoid cells on each side of the upper part of the nose, and the passage of the optic nerve to each eye.

Much has been said at this meeting about the influence of the tongue. The books of anatomy do not give a correct idea of the size and position occupied by the tongue. If we quote Gray, which is the principal text-book used in the dental and medical schools of America, we find the following: The tongue "is situated in the floor of the mouth between the two portions of the body of the lower jaw."

This gives an incorrect idea of the tongue. A better short description would be: the tongue is within the mouth, its base attached to the floor; it fills the oral cavity from the floor to the roof with the slight exception of a small space left between the dorsum of the tongue and the roof of the mouth and extends from the anterior teeth almost to the post-pharyngeal wall and from the teeth on one side to those on the other, and when the teeth are lost it extends into the spaces that were occupied by these teeth until the tongue, cheeks and lips often come in contact or overlap each other.

Fig. 18 is an illustration made from a sagittal section cut through the center of the head. It will be noticed that the teeth are not quite in occlusion and the lips are a little apart; nevertheless it can be observed how completely the mouth is filled by the tongue which extends far back until it nearly comes in contact with the post-pharyngeal wall. The fibers of the tongue will be noticed radiating backward and upward from the genital turbucles. The lower ones are the genio-hyoid; the upper, the genio-hyoglossus.

Anatomists generally describe the mouth as extending back to the pillars of the fauces. It would be better to describe it extending back to nearly the post-pharyngeal wall. The nose should also be described as extending backward to the post-pharyngeal wall instead of the free edge of the internal plate of the pterygoid process.


Nose.
Nostril.
Maxilla.
Septum of nose.
Nasal fossæ.
Maxillary sinus.
Inferior turbinate.
Upper portion of inferior meatus.
Malar process.
Tip of corinoid process.
Masseter muscle.
Upper head of the external pterygoid.
Lower half of the external pterygoid.
Pterygoid process.
Head of condyloid process.
Rectus capritis anticus major.
Rectus capritis anticus minor.
Upper portion parotid gland.
Internal carotid artery.
Internal jugular vein.
Jugular process of occipital bone.
Mastoid cells.
Spinal cord.
Under portion of cerebellum.
Bone surrounding foramen magnum.

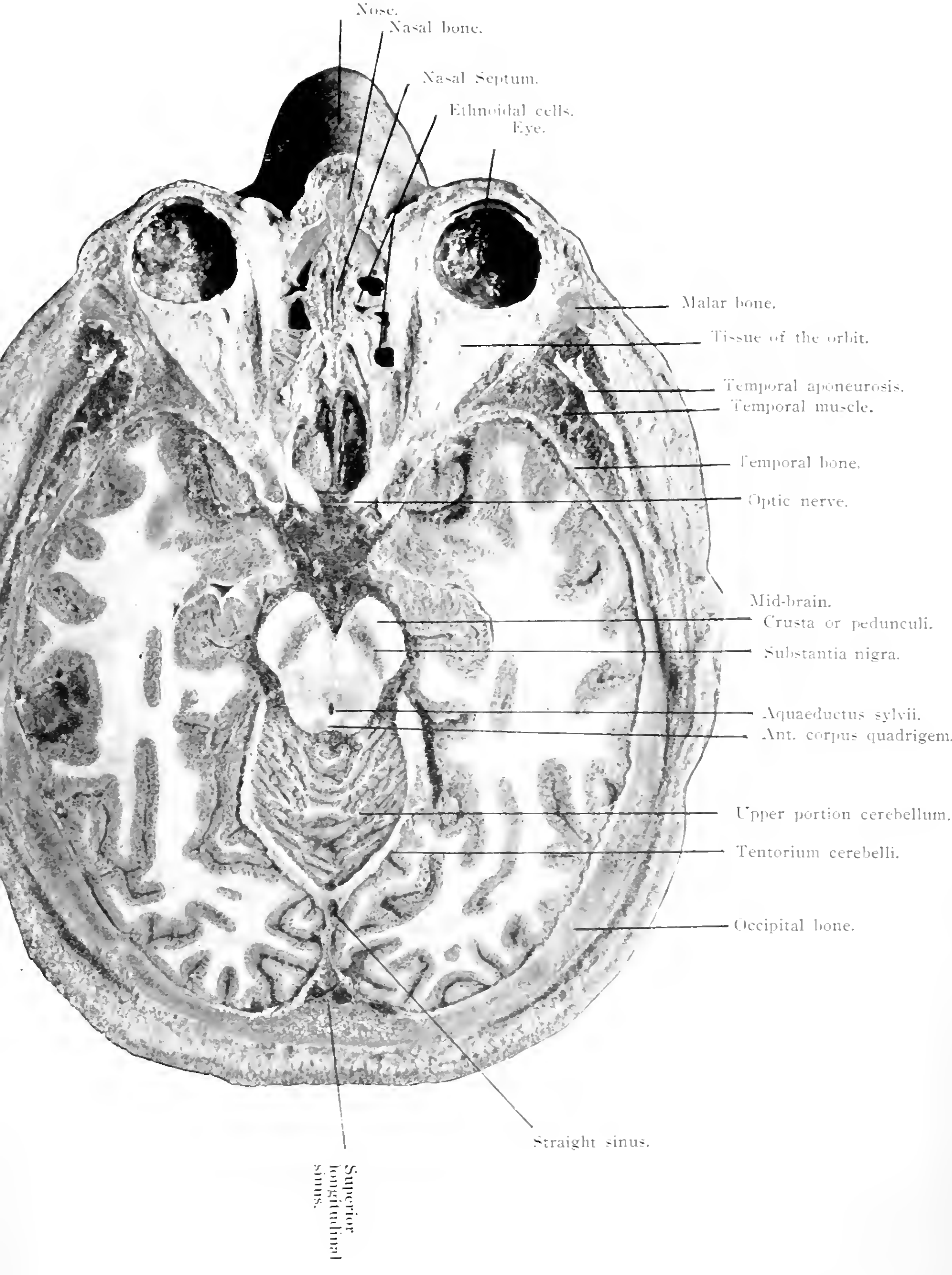
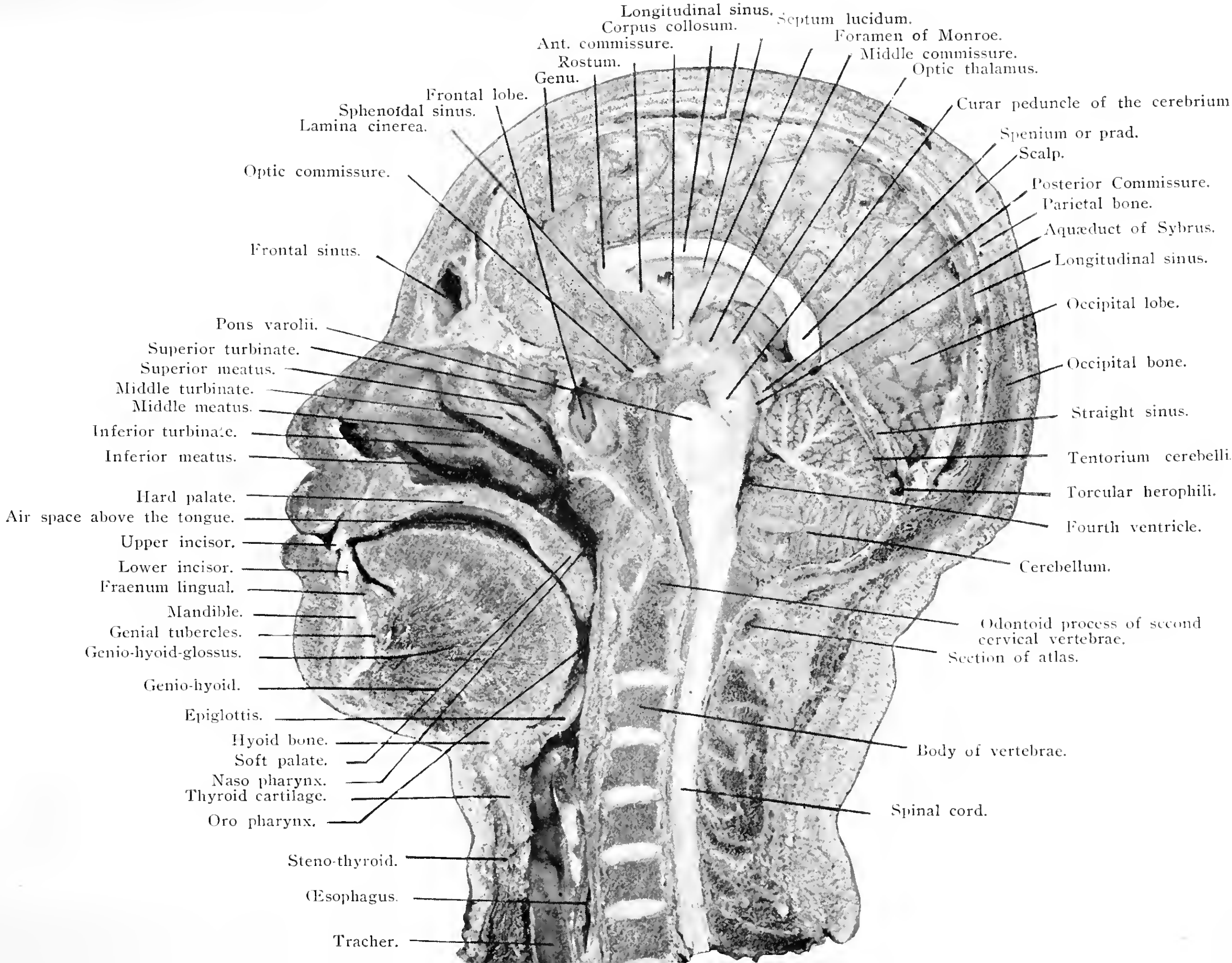

Nose.
Nasal bone.
Nasal Septum.
Ethmoidal cells.
Eye.
Malar bone.
Tissue of the orbit.
Temporal aponeurosis.
Temporal muscle.
Temporal bone.
Optic nerve.
Mid-brain.
Crusta or pedunculi.
Substantia nigra.
Aquaeductus sylvii.
Ant. corpus quadrigem.
Upper portion cerebellum.
Tentorium cerebelli.
Occipital bone.
Straight sinus.
Superior longitudinal sinus.

Fig. 17.


Longitudinal sinus.
Corpus collosum.
Ant. commissure.
Rostum.
Genu.
Frontal lobe.
Sphenoidal sinus.
Lamina cinerea.
Optic commissure.
Frontal sinus.
Pons varolii.
Superior turbinate.
Superior meatus.
Middle turbinate.
Middle meatus.
Inferior turbinate.
Inferior meatus.
Hard palate.
Air space above the tongue.
Upper incisor.
Lower incisor.
Fraenum lingual.
Mandible.
Genial tubercles.
Genio-hyoid-glossus.
Genio-hyoid.
Epiglottis.
Hyoid bone.
Soft palate.
Naso pharynx.
Thyroid cartilage.
Oro pharynx.
Steno-thyroid.
Œsophagus.
Tracher.
Septum lucidum.
Foramen of Monroe.
Middle commissure.
Optic thalamus.
Curar peduncle of the cerebrium
Spenium or prad.
Scalp.
Posterior Commissure.
Parietal bone.
Aquæduct of Sybrus.
Longitudinal sinus.
Occipital lobe.
Occipital bone.
Straight sinus.
Tentorium cerebelli.
Torcular herophili.
Fourth ventricle.
Cerebellum.
Odontoid process of second cervical vertebrae.
Section of atlas.
Body of vertebrae.
Spinal cord.

The epiglottis will be noticed at the posterior base of the tongue passing upward and backward. In discussing a paper some time ago, the sudden collapse of a patient was thought by some to be due to the tongue falling backward, which caused the epiglottis to close over the glottis. This I thought was partly a mistake as I do not believe that the epiglottis acts as a lid to the glottis. It is more of a stationary organ and its nearest relation to the glottis is when the larynx is raised toward it; even at that time the epiglottis is carried upward with the base of the tongue and the hyoid bone. Some years ago I made a number of experiments upon several cats and dogs. After placing them under an anesthetic I opened the tissue covering the region of the glottis and epiglottis in order to obtain a general view of the parts, allowing the teeth to remain in occlusion. By passing water into the posterior parts of the mouth with a syringe, deglutition was forced. The water passed backward and downward and in the act of deglutition the folds of the glottis would close the opening, but no special movement of the epiglottis could be observed even when the water was injected between the folds of the glottis. The epiglottis has sometimes been lost in man by disease and traumatism without interfering with the functions of the glottis and in many of the lower animals no epiglottis exists at or near the glottis at the base of the tongue, showing that it is not necessary for this organ to protect the glottis. I have removed the organ from several cats and allowed the parts to heal over with no apparent difference in the deglutition or breathing. As the epiglottis is a concavo-convex organ, with the convex portion toward the mouth, it will act as a shield to the glottis and cause the fluids to go to the right and left as they pass the partly raised tissue surrounding the glottis.

Fig. 19 is an illustration made from a vertical transverse section cut through the frontal sinuses, the orbits, nasal chamber, the maxillary sinuses, the roof of the mouth, the tongue, etc. It shows that the tongue fills the mouth completely in a transverse section, excepting just above the dorsum. The vessels of the tongue are seen on each side of the raphé. It will be noticed that where the lower molars are lost, the tongue sends a small process laterally to partly fill the space. As the tongue naturally fills the space from side to side, the cavity produced by an extracted tooth seems, to the patient, much larger than it really is, but in a few days the tongue sends out a process which partially fills the space and the loss of the tooth is no longer noticed.

It is the opinion of Dr. Grevers and others that the tongue has a great influence in moulding the shape of the mouth. There is no

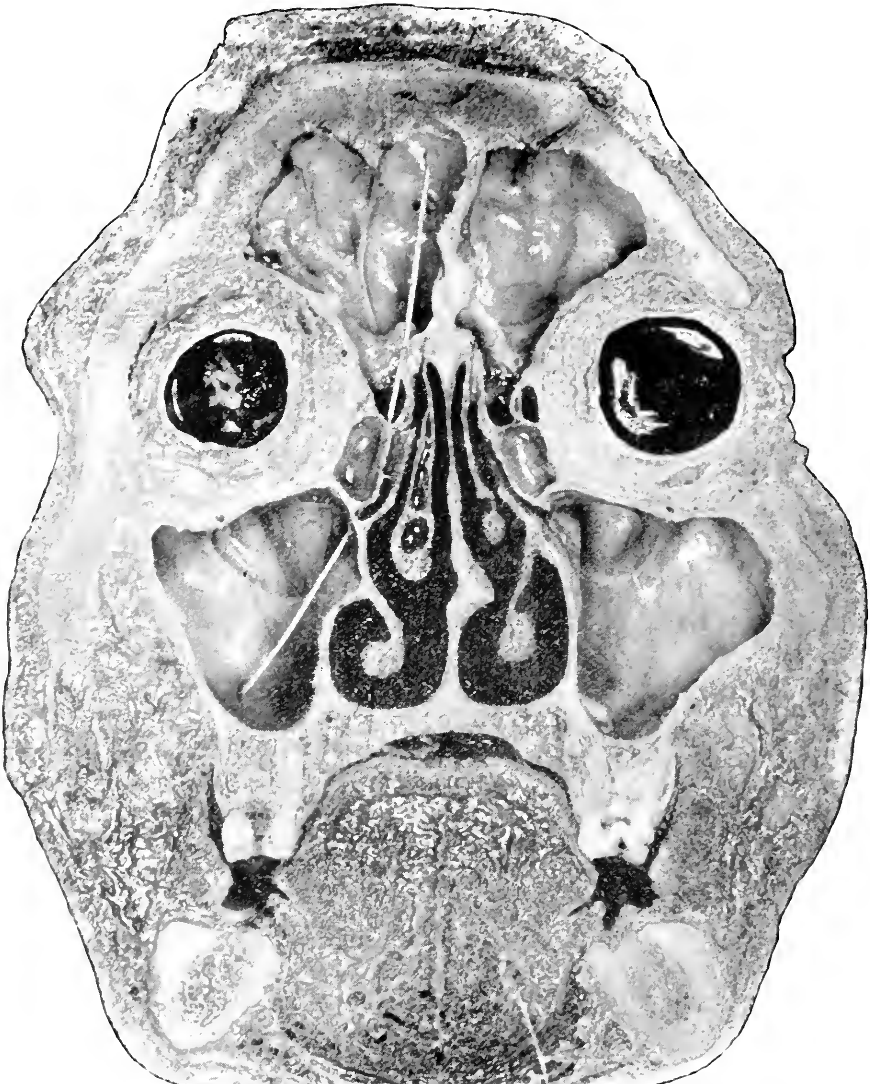


Fig. 19.

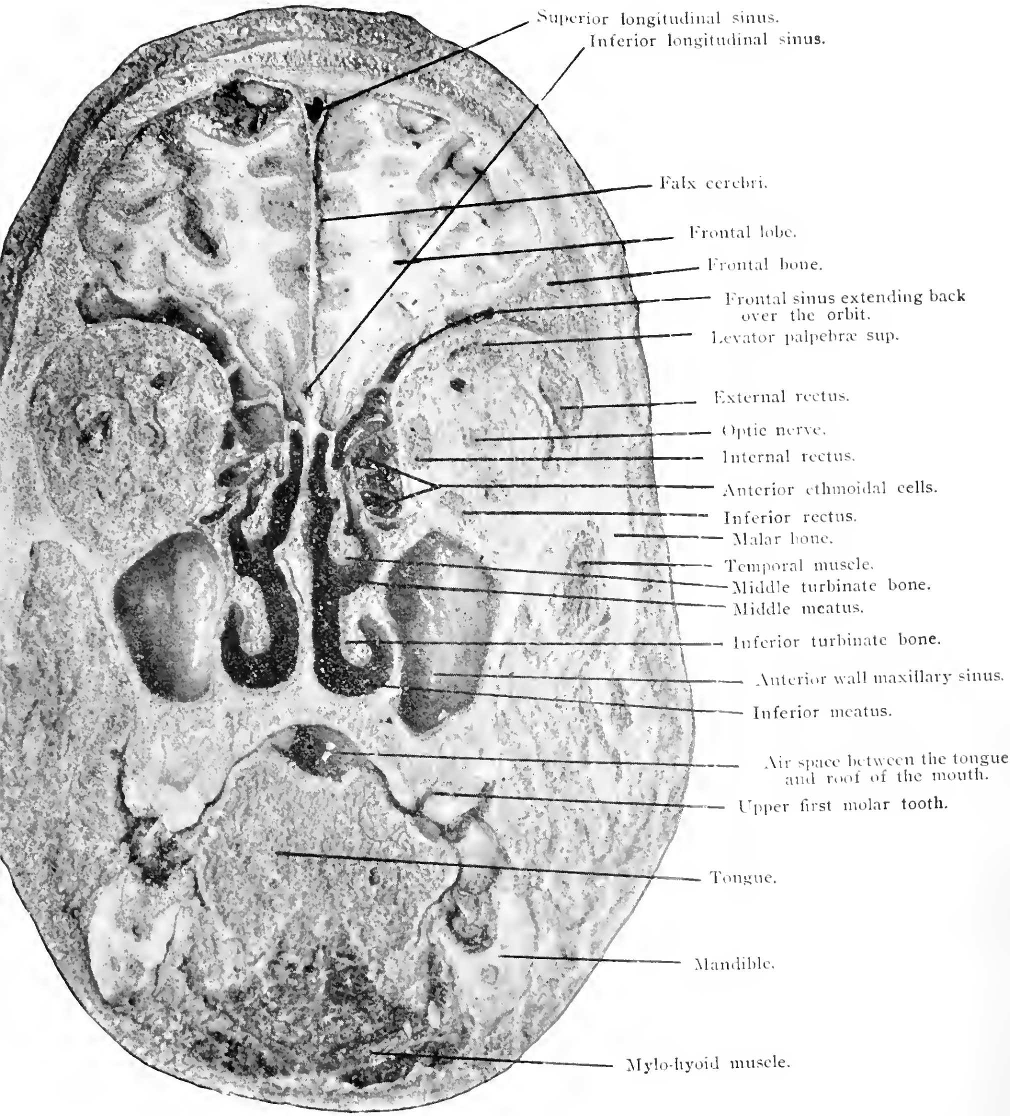

Superior longitudinal sinus.
Inferior longitudinal sinus.
Falx cerebri.
Frontal lobe.
Frontal bone.
Frontal sinus extending back over the orbit.
Levator palpebræ sup.
External rectus.
Optic nerve.
Internal rectus.
Anterior ethmoidal cells.
Inferior rectus.
Malar bone.
Temporal muscle.
Middle turbinate bone.
Middle meatus.
Inferior turbinate bone.
Anterior wall maxillary sinus.
Inferior meatus.
Air space between the tongue and roof of the mouth.
Upper first molar tooth.
Tongue.
Mandible.
Mylo-hyoid muscle.

Fig. 20.

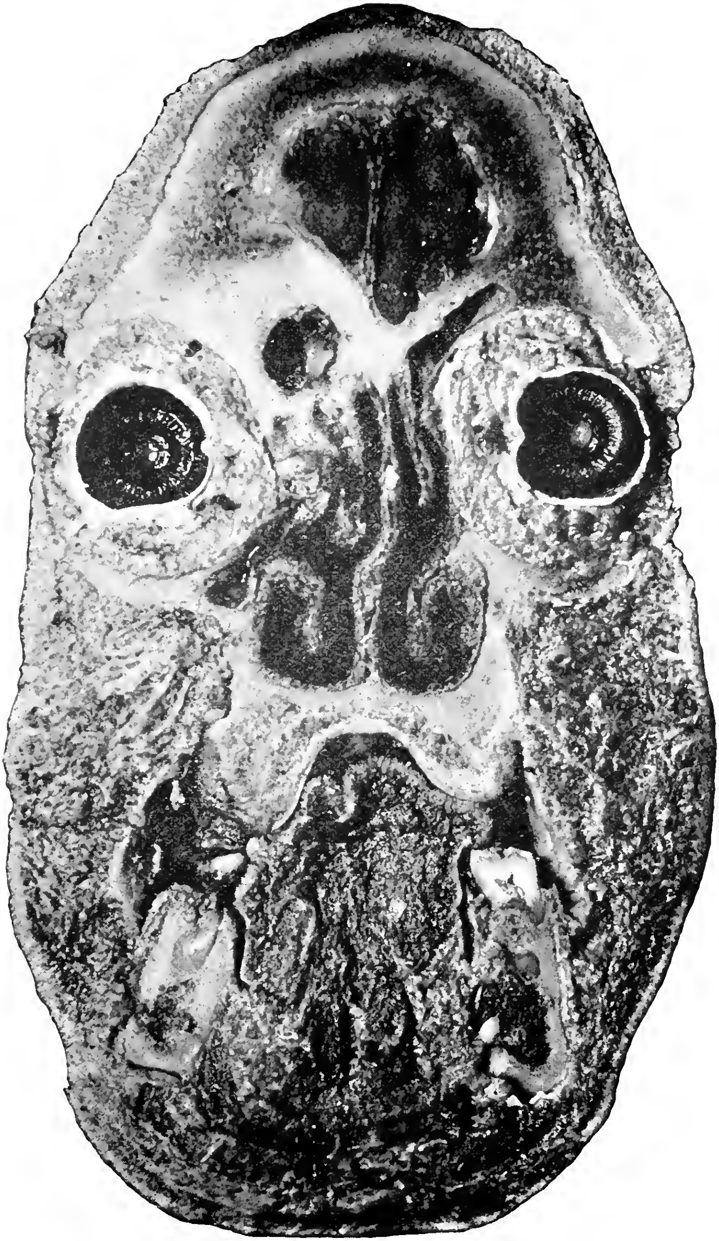


Fig. 21.

doubt that it has some influence, but judging from many sections I am inclined to believe that the mouth has much more to do with modifying the shape of the tongue. Where the mouth is of a typical shape as those shown in the last two illustrations, the tongue is comparatively smooth in its general outline and conforms to the shape of the wall of the mouth and teeth, but as seen in Fig. 19, where two teeth have been lost, there are processes thrown out from the tongue to fill the space as though the pressure upon the balance of the tongue forced this projection into a space where the lateral pressure had been moved.

Fig. 20 is an illustration made from another vertical transverse section where the face has been narrowed, the mouth compressed, and a few teeth lost. The tongue is irregular in its outline, indicating to me that the mouth has had more influence in modifying the tongue than the tongue the mouth.

Fig. 21 is an illustration made from a similar section as that of Fig. 20. The face is so compressed that there is no maxillary sinus on the right side and a very slight one on the left side. A narrow nasal fossa, a deflected septum, deteriorated turbinated bone, etc., will be noticed. The alveolar processes of the upper jaw have been pressed inward, thus forming what is known as a high arch; if these processes were spread outwards into their typical positions, the arch would not be high. The lower jaw is so compressed as to leave little room between its two lateral halves and the narrowed upper mouth for the tongue. Consequently the tongue is compressed and deformed and has apparently had no influence in forming the shape of the mouth.

Fig. 22 is an illustration made also from a narrow faced person with a compressed nasal fossa, a deflected septum, lack of development of the ethmoidal cells, small maxillary sinuses; the alveolar arches are narrow, the tongue compressed, part of it passing out between the jaws until it meets the cheek. When such a condition is found in this region of the skull, it usually indicates that the posterior nares are more or less obstructed with either bony deposit or enlarged adenoid tissue.

Fig. 23 is an illustration made from the same skull as Fig. 22, cut at or near the posterior nares. It will be observed that the nasopharynx is almost filled up with enlarged glandular tissue. This enlargement extends for a considerable distance along the air passage of this region. The passage is so obstructed that it would compel mouth breathing.

Fig. 24 is an illustration made from a vertical transverse section

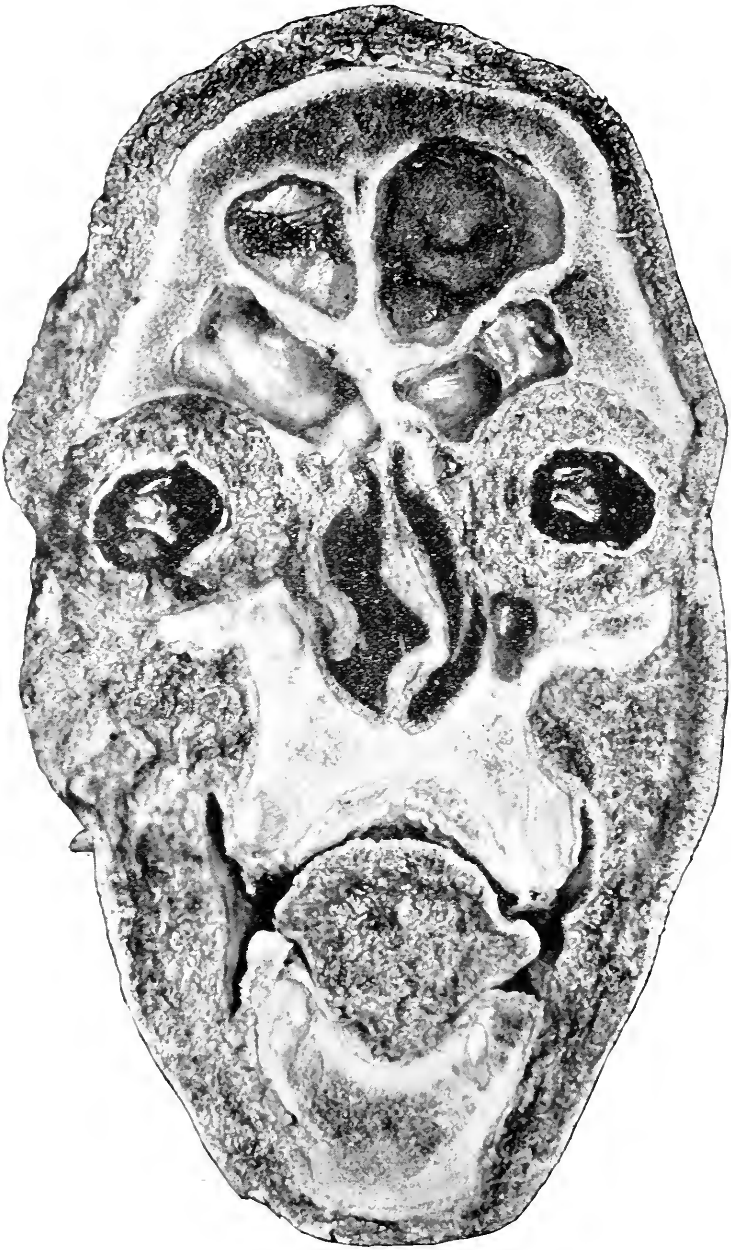


Fig. 22.

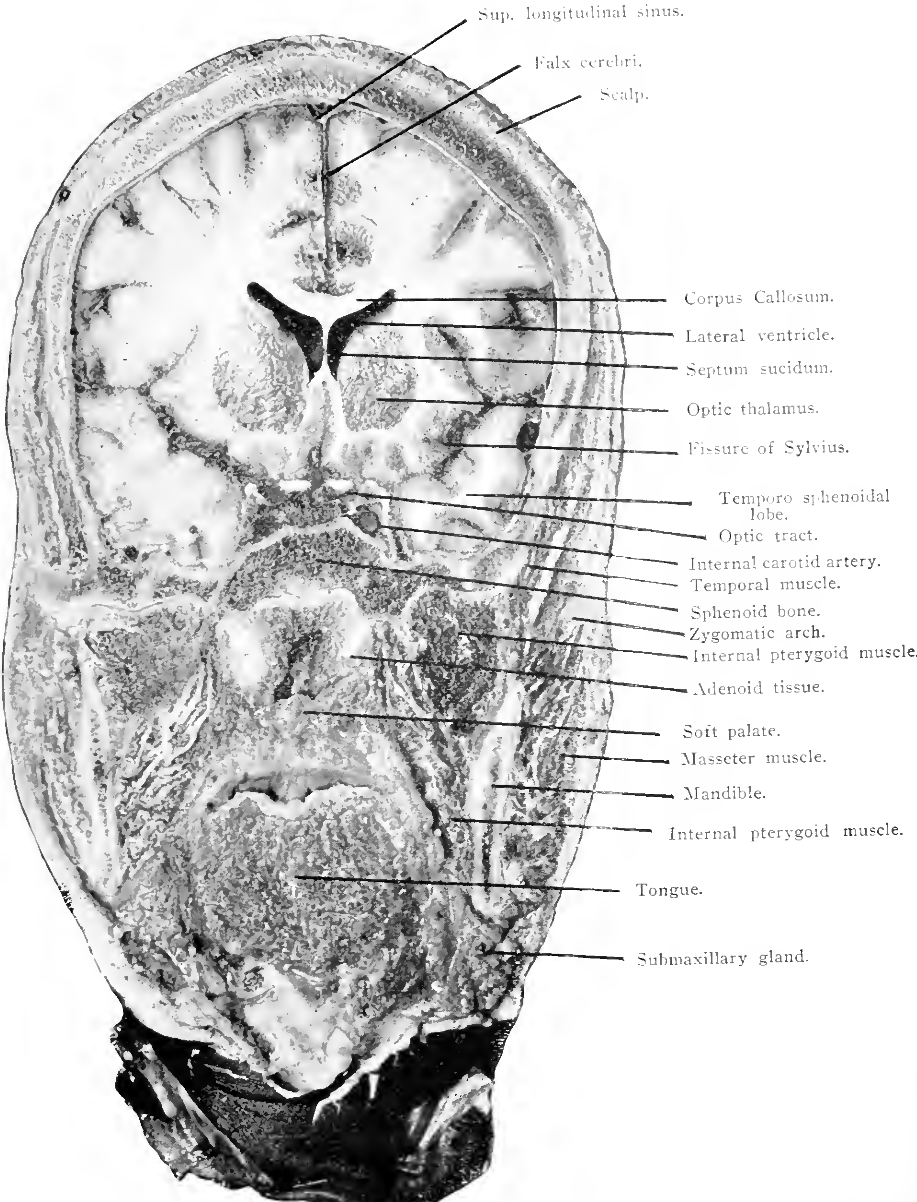
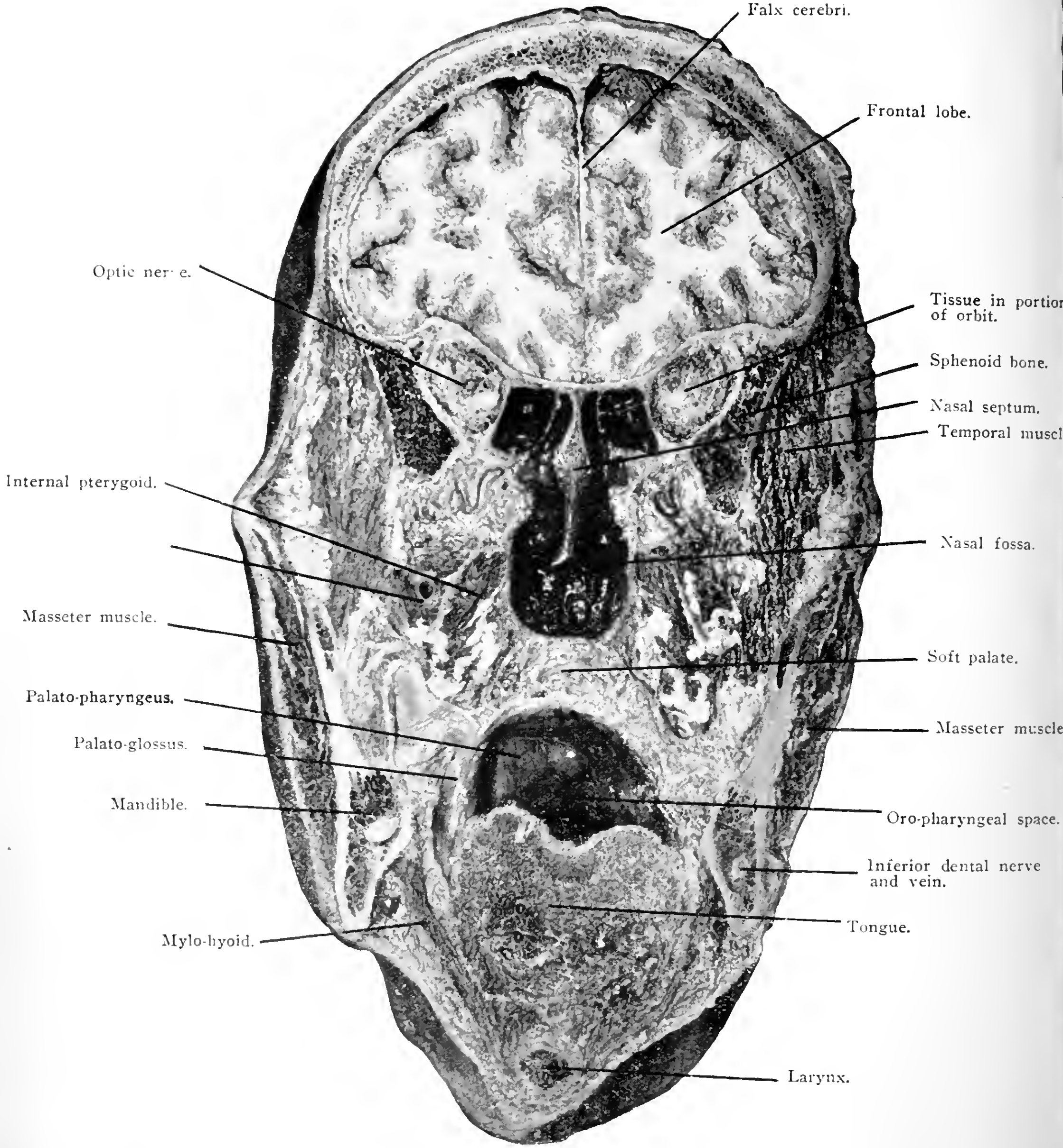

Sup. longitudinal sinus.
Falx cerebri.
Scalp.
Corpus Callosum.
Lateral ventricle.
Septum sucidum.
Optic thalamus.
Fissure of Sylvius.
Temporo sphenoidal lobe.
Optic tract.
Internal carotid artery.
Temporal muscle.
Sphenoid bone.
Zygomatic arch.
Internal pterygoid muscle.
Adenoid tissue.
Soft palate.
Masseter muscle.
Mandible.
Internal pterygoid muscle.
Tongue.
Submaxillary gland.

Fig. 23.



Falx cerebri.
Frontal lobe.
Optic ner- e.
Tissue in portion of orbit.
Sphenoid bone.
Nasal septum.
Temporal muscle
Internal pterygoid.
Nasal fossa.
Masseter muscle.
Soft palate.
Palato-pharyngeus.
Masseter muscle.
Palato-glossus.
Mandible.
Oro-pharyngeal space.
Inferior dental nerve and vein.
Tongue.
Mylo-hyoid.
Larynx.

Fig. 24.

cut in the region of the rami of the mandible showing when the mouth is thrown open the hyoid bone and all that is attached to it are drawn downward. The tongue is drawn from the roof of the mouth thus giving passage way for the air. This also puts the elevating muscles of the tongue, of the hyoid bone, of the pharynx and the other structures that are closely associated with them on a tension. The muscles of mastication are also stretched. In this way the muscles of the face must be influenced to a certain extent, but in my opinion the lack of constant occlusion of the teeth is the greatest factor in not forcing the teeth and the alveolar processes outward, thus causing what is generally termed the high arches of the mouth.

Fig. 25 is an illustration giving an anterior view of a vertical transverse section, made through the frontal lobes, the anterior portion of the spheno-temporal lobes, the sphenoidal sinuses, the naso-pharynx, the soft palate, the tongue, the hyoid bone, and the thyroid and cricoid cartilages. It also illustrates sections made through certain bones of the brain case, the temporal muscles, the external and internal pterygoid muscles, the pterygoid processes, the internal maxillary arteries, the rami of the mandible, the submaxillary gland, the thyro-hyoid muscle, and the sterno-thyroid muscle. This illustration is taken from an almost typical skull. It is nearly symmetrical. There is plenty of breathing space through the naso-pharynx making a marked contrast to Fig. 23 which is cut in about the same region. If an incision be made around the base of the tongue, and that portion of the tongue be removed, it will expose what is usually known as the oro-pharyngeal space as shown in Fig. 26.

Fig. 26 is a similar section to Fig. 25 and affords a view of about the same anatomical structures except that the tongue has been removed. In addition it gives a view of the anatomical structure of the oro-pharyngeal space. In the upper portion of the center of this space will be noticed the uvula, below which and extending downward is the post-pharyngeal wall, and at the bottom of this space may be seen the convex surface of the epiglottis. In the upper and outer corners of the space are the tonsils. To the inner side of the tonsils portions of the palato-pharyngeal muscles are shown, while to the outer side, and slightly covering the tonsils, anteriorly, are the palato-glossus muscles.

Dr. Kohler gave the impression in his paper that dentists were not aware that adenoid enlargements or obstructions of the air passages of the nose and upper part of the pharynx are factors in causing irregularities of the teeth or malformation of the mouth. This is a great mistake, as Prof. Harrison Allen, as early as 1874, taught his den-

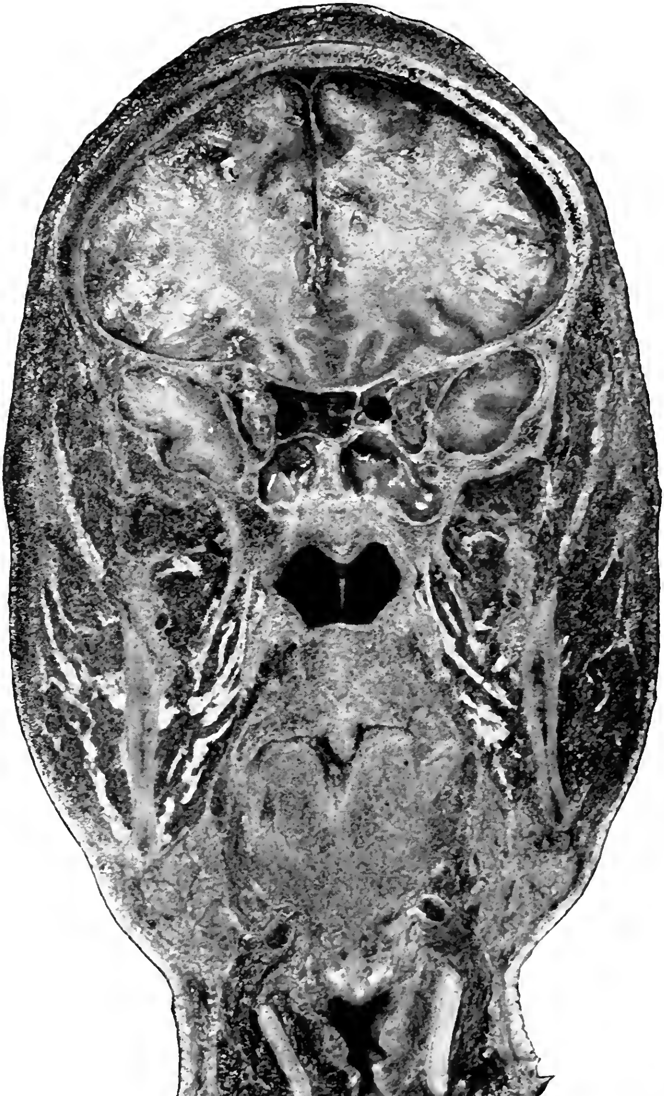


Fig. 25.

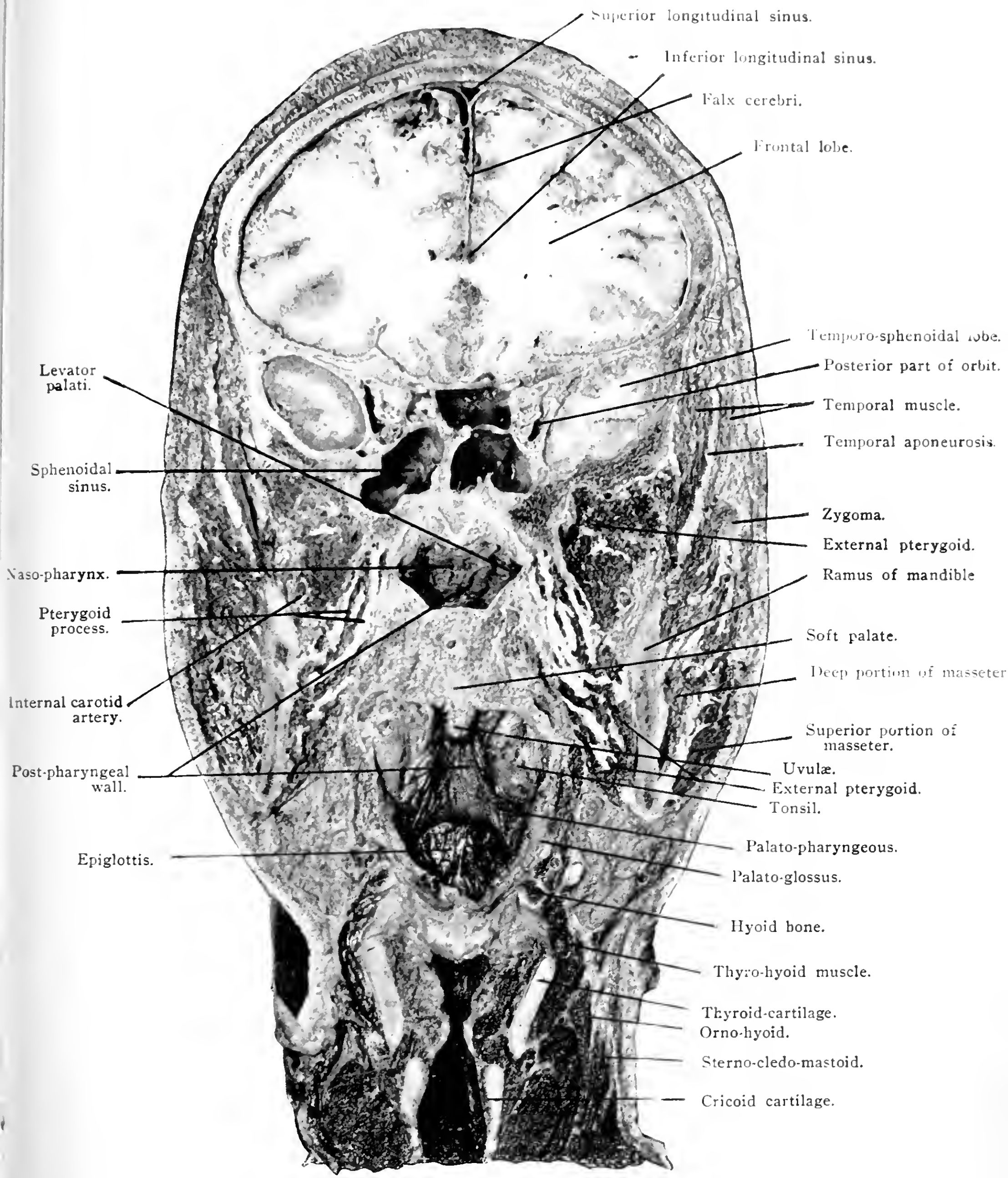

Superior longitudinal sinus.
Inferior longitudinal sinus.
Falx cerebri.
Frontal lobe.
Temporo-sphenoidal lobe.
Posterior part of orbit.
Temporal muscle.
Temporal aponeurosis.
Zygoma.
External pterygoid.
Ramus of mandible
Soft palate.
Deep portion of masseter
Superior portion of masseter.
Uvulæ.
External pterygoid.
Tonsil.
Palato-pharyngeous.
Palato-glossus.
Hyoid bone.
Thyro-hyoid muscle.
Thyroid-cartilage.
Orno-hyoid.
Sterno-cledo-mastoid.
Cricoid cartilage.
Levator palati.
Sphenoidal sinus.
Naso-pharynx.
Pterygoid process.
Internal carotid artery.
Post-pharyngeal wall.
Epiglottis.

Fig. 26.

tal class at the Philadelphia Dental College that undue tension of the muscles of the palate would influence the shape of the mouth and position of the teeth, and also that enlargements of the oral tonsils and glandular tissue above the palate have this same influence in producing abnormal shapes of mouth and nasal cavity. This has been recognized by dentists generally, and is recorded in some of their text-books.

It will be very evident from the illustrations given you and the anatomical points brought out, that I consider that the orthodontist should be familiar with the anatomical structures of the bones of the face, and especially those giving support to the alveolar processes of the teeth. Their development, the physiological changes and pathological conditions, both local and constitutional, should be observed. The influence of normal and abnormal muscular action upon the shape of the bones of the jaws and the face should be well considered. Pathological enlargement of glandular tissue, whether it be acute or chronic, should have the closest attention, especially if these conditions will induce mouth-breathing, thus preventing normal occlusion of the teeth. Inflamed conditions of the alveolar processes which are caused by various diseases, etc., should also be treated as this condition will prevent the percussive force of the mandible, through the teeth, against the upper jaw, and whenever this is the case in the growing jaw it will cause malformation of the face and malposition of the teeth. From this standpoint I should consider the orthodontist's first duty to be the correction of pathological conditions of the structures spoken of, before resorting to mechanical means.

Distal Movement of Molars and Bicuspids.

By Lloyd S. Lourie, D.D.S., Chicago, Ill.

With the establishment of orthodontia as a distinct specialty, there ought to be a noticeable improvement in the the standard of results obtained by those engaged in its practice. The specialists cannot be satisfied with a simple improvement in the positions of the teeth, but must strive for the best occlusion and the best facial expression compatible with the peculiarities and type of the patient.

The few suggestions of this paper relate specially to conditions in which the requirements of occlusion and facial symmetry are intimately blended; cases, in which it may seem impossible to obtain the desired occlusion without disfiguring the face by undue prominence of the lips; cases, which generally suggest extraction and the saying that "the teeth are too large for the jaws."

Malposition of the First Molar.

Undoubtedly this may occasionally be true, but too often irregularities are placed in that class through faults in diagnosis. It may be that no allowance is made for the probable development of the face to accommodate such teeth, after they have been regulated, and a further mistake is made in considering the first permanent molars as fixed points in the dental arch and that all expansion must be labially and buccally. The importance given the first molar as the most constant in its position may be responsible for this apparent indifference to the fact that it may change its position mesially as well as buccally or lingually.

It is well known that the early loss of deciduous molars or cuspids or the tardy eruption of bicuspids or permanent cuspids will allow the permanent molars to move mesially, and that is just what has taken place in many of these cases. It will be found that the molars and probably the bicuspids are forward of their normal position relative to the face. The upper and lower molars may be in normal relation with each other, mesio-distally, yet both may be forward of normal relation to the face, or such malposition of molars may be associated with any variety of malocclusion. Figures 1 and 2 illustrate types that are quite common. In the first, both upper and lower molars and bicuspids have moved forward together, possibly from early loss of temporary cuspids, while, in the second, the change has been limited to the uppers. Figure 3 shows the

teeth of a child 8 years of age, whose upper first permanent molar has moved forward, carrying with it the second temporary molar. The protrusion of the upper incisors was caused by thumb sucking and did not affect the other teeth, for the cuspids in the illustration are seen to be in

Fig. 1.

normal occlusion, as are also the teeth in the opposite side of the mouth. It will, doubtless, be allowed that such shifting of molars is a common occurrence, and, granting that it is, how shall it affect treatment?

If all of the teeth are aligned and the position of the molars un-

Fig. 2.

changed distally, the lips must necessarily be made too prominent. On the other hand, anyone who fully appreciates the value of each and all of the teeth, will avoid extraction, if it is possible to do so. The general objections to extraction as a corrective procedure are so well known as

to require no discussion, but it may not be amiss to suggest special objections in the cases under consideration. Ordinarily, the six anterior teeth are the objects of concern in attempts at improving the contour of the lips and extraction usually makes more room than is actually needed to allow them to be placed as desired. To close this extra space, the anterior teeth are moved lingually, the median line disturbed, or the molar moved farther forward. Again, extraction in one arch may necessitate all of the tooth movement taking place in that arch, when a study of the face indicates that it should be partly in each arch. Best results can be obtained only when the teeth are placed in normal relation to the face, as well as to one another.

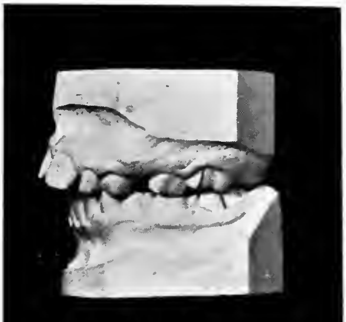


Fig. 3.

Distal Movement of Molars.

The rational solution of the problem is to move the molars distally, placing them in normal position, if possible, and, as this is done so seldom, one is led to believe that it is considered too difficult to be practicable. However, it is not only possible, but frequently advisable and can be brought about along with other movements, if care is exercised in selecting anchorage and applying force. The main point in treatment is to see that force is applied directly to the molars. It would seem unnecessary to mention this, but attempts have been made to move the teeth distally by applying force at the center of the arch over the incisors, which necessitates overcoming the resistance of all the teeth at once, instead of a few at a time, as when molars are moved first.

For convenience in description, treatment may be divided into two classes according to the anchorage required. In the first, teeth in the same arch are used for anchorage, while in the second those in the opposing arch are used. Occipital anchorage may be used to reinforce either of these.

Case I from Practice.

Figure 4 illustrates the first method in a case requiring most of the distal movement for the upper molars and bicuspids. Treatment was commenced in January, 1901, and the movement in the upper arch occupied two months, the patient being a young lady 18 years of age. An expansion arch was used to bring about labial movement of incisors and distal movement of molars at the same time. Ordinarily, the orthodontist is careful to favor his molar anchorage and be certain of moving the incisors by attempting to move only one or two at a time, but to move molars, all of the anterior teeth are attached at once to create as much resistance as possible. In this case, the first and second molars were moved at the same time and then the bicuspids, but it is preferable to move the second molars first, in difficult cases. The second view (Fig. 4) shows the positions of the teeth immediately after removal of moving appliances, and, though occlusion is not finally adjusted, the change in the molars and bicuspids is readily seen. After provision has been made for the retention of the improved arrangement of cuspids and incisors, their distal tendency plus lip pressure affords the necessary retaining influence for molars and bicuspids.

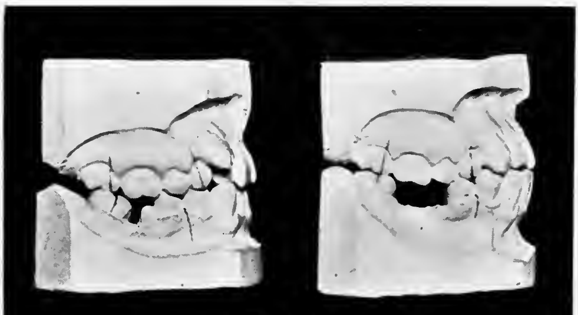
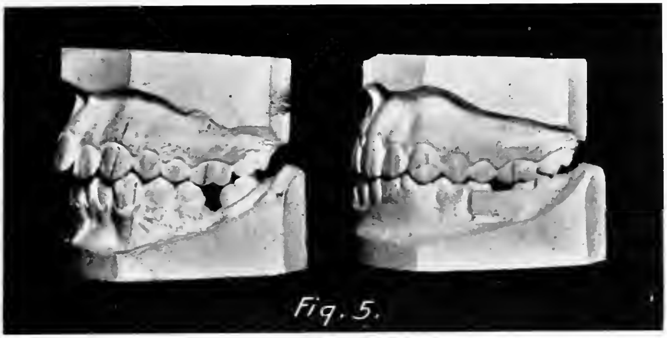


Fig. 4.

Case II from Practice.

Figure 5 illustrates the second method in a case requiring distal movement of the left upper molars and bicuspids, using the opposing arch for anchorage. Treatment was begun in March, 1902, and the movement in the upper arch occupied about three months, the patient being a young lady 14 years of age. An expansion arch was used on the upper teeth for the attachment of the "Baker anchorage" (Fig. 6), which moved the molars distally, at the same time reinforcing the anchorage used in regu-

lating the lowers. In the original use of the "Baker anchorage" an Angle "B" arch was used, making anchorage of practically all of the upper teeth for the purpose of moving the lowers forward, but an expansion arch is preferable, if the upper teeth are to be moved distally. The nuts upon this arch may be so adjusted as to keep the force applied directly to the molars,



as it should be. The second view of Fig. 5 is simply to show the change in position of the upper teeth. The occlusion is not quite what it should be, as the lowers were not completed when the models were made. If the lower molars were to be moved distally, instead of the uppers, the same treatment would apply, the anchorage being reversed.

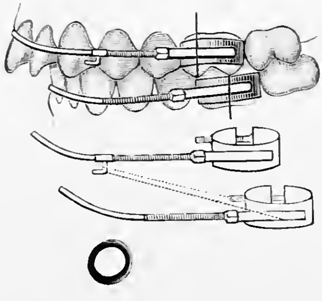


Fig. 6.

The retention for such cases is that ordinarily used after jumping the bite. In this particular case, retention was provided by an inclined plane in the form of an extra cusp on the lingual side of the upper cuspid (Fig. 7). This, occluding with the lower cuspid, prevents the uppers from moving mesially.

Discussion.

In calling for discussion of the paper, the Chairman said:

The question of whether the upper teeth actually move forward or not is one that has been often debated. This is material for discussion for us.

Dr. Monroe. Less than a year ago I visited Dr. Lourie in his office in Chicago and had the pleasure of comparing notes on different things that can be used with that wonderful system of Angle regulating and the forces that can be applied through that arch was demonstrated to me and led me to make applications of the paper that has been read this evening, although it never appeared to me in the way it has today.

In my own practice I had a case of marked retrusion of the lower jaw and the condition of the molar prevented the proper elevation of the

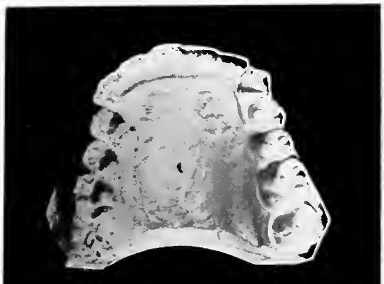


Fig. 7.

bicuspid. By means of the arch in front of the anterior teeth I moved the molars back as the doctor has suggested and thereby obtained plenty of room for the elevation and eruption of the bicuspid which was so crowded. I simply state this to verify the idea presented. It is just another example of the power properly applied through this arch as being able to reach any and all cases in orthodontia.

In answer to a question by some one, Dr. Lourie stated that the appliance had been on about three weeks.

Dr. Pullen. I wish to commend Dr. Lourie's paper because of the fact that it has added some very valuable points and methods in the use of the expansion arch. It seems to me that the possibilities of this arch are almost limitless.

Speaking of the mesial of forward movement of the molars and bicuspids, I have noticed that lately in a number of cases. I have in my pocket a couple of photographs of a case similar to the one Dr. Lourie

showed you on the screen. (Photographs produced and passed around for examination.)

Dr. Weeks. I want to thank him for the presentation of the matter. It is the first time I have heard it spoken of in a society, and I think it is something the value of which is almost inestimable. I want to thank him for the idea.

Dr. Lourie in closing said he had nothing further to say especially, except that it had been a great gratification to him that there had not been as much criticism as he had expected, and thanked the society for the approval they expressed apparently by the lack of criticism.

The meeting then adjourned.

Fixed and Removable Appliances, Alone and in Combination.

By Herbert A. Pullen, D.D.S., Buffalo, N. Y.

In presenting before this society a paper differing in its ideas somewhat from that of the advocates of either the fixed or removable system of appliances, I wish to say at the outset that I am not trying to advance any new theories or make unfavorable comparisons, but to show that it is possible to use both systems in practice, even in combination, in the same case to good effect and to better advantage than if one were limited to the use of but one of the two systems.

Adaptability is a quality which I believe we should cultivate, but it is impossible to appreciate the virtue in it unless we are broad enough to be eclectic.

One System Undesirable. The originators of systems deserve our most profound respect and esteem for the benefits we have received as the result of their many years of untiring labor in behalf of the science of orthodontia, and it is only natural that they should believe that the system which has been their own creation should seem the best to use in all cases. But to the student of both systems, the question of choice will always be paramount, if his knowledge and experience have proven to him that of two methods of managing a case, one is more advisable at one time than the other, whether by reason of freedom from pain, inconspicuousness, fixedness of appliance, cleanliness, shortening of the time of operation, or performing the same with the greatest amount of comfort to both patient

and operator as in requiring less attention and consequent less frequent appointments, etc.

Case I from Practice. The first case which I shall consider and which is represented in Figs. 1, 2 and 3, is one of unilateral distal occlusion; the treatment indicated being the harmonizing of the occlusion on the right side by extraction of an upper bicuspid and retrusion of the upper incisors and cuspids; or a unilateral jumping of the bite on the same side, with correction of the pointed shape of the arch, and restoration of the faulty facial lines. The former method was chosen, and the appliances used are shown on the models (Fig. 2), being the well known Angle appliances; the contraction arch and trac-

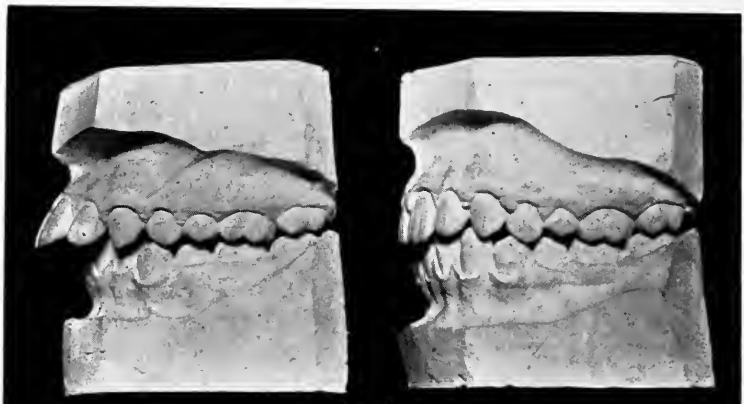


Fig. 1.

tion screw in connection with the headgear being used on the upper arch, and the expansion arch alone on the lower. The models before and after Fig. 1 show the result of the treatment. The novel feature of the case is represented by the retention of the upper teeth after treatment was concluded and consists of a removable appliance constructed after the Jackson method, which not only retains the teeth in position, but exerts a gentle retractive force sufficient to guard against any possible return of the teeth to their former malposition. The retention of the two arches is illustrated in Fig. 3. Although the removable appliance on the upper arch is here used simply as a retainer, it might have been used to perform the operation of reduction of the anterior protrusion but would have taken much longer time than if the headgear and fixed appliances were used. The retention of the lower arch consists of the cemented bands on cuspids, joined by the soldered wire.

Case II. The next case I shall describe, Figs. 4 and 5, is illustrative of a case for which the fixed system furnishes no specified appliance for the reduction of the superior protrusion without the use of the headgear unless rubber bands or coiled springs are used with an arch sliding through tubes on

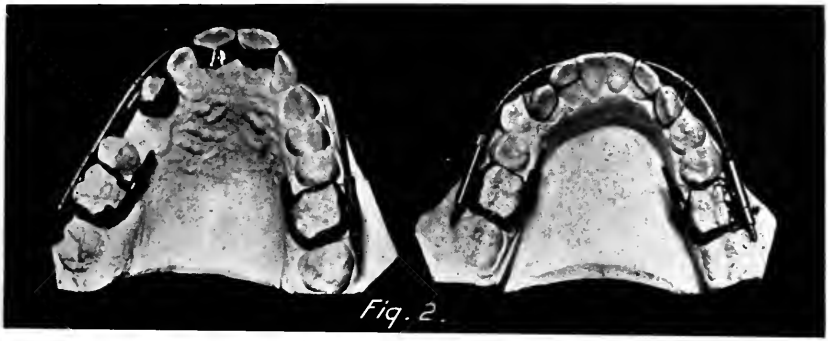


Fig. 2.

molar bands, while with the removable appliance, as constructed in this case, the use of the headgear is entirely unnecessary, a point of very great importance. With the use of the Baker anchorage the protrusion could have been reduced, but would have required wire arches on both upper and lower teeth, while the operation as performed in this case was limited to the use of but a single appliance.

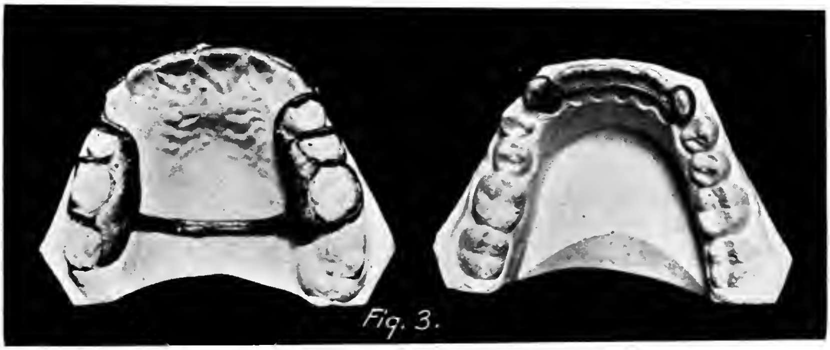


Fig. 3.

This appliance deserves honorable mention among the list of those that should be and are in common use today. Its construction is simple, being a combination of the roof-plate and the Jackson spring clasp attachments. Just at this point I wish to observe that the plate as used in this combination forms one of the most cleanly appliances that we have, which

is contrary to the opinions of many who probably have not given it a trial. Another very wonderful thing that this appliance will do is to depress the incisors in their sockets after the reduction of the protrusion by reason of the pressure on the double inclined planes buccally and lingually, by the spring wire plate.

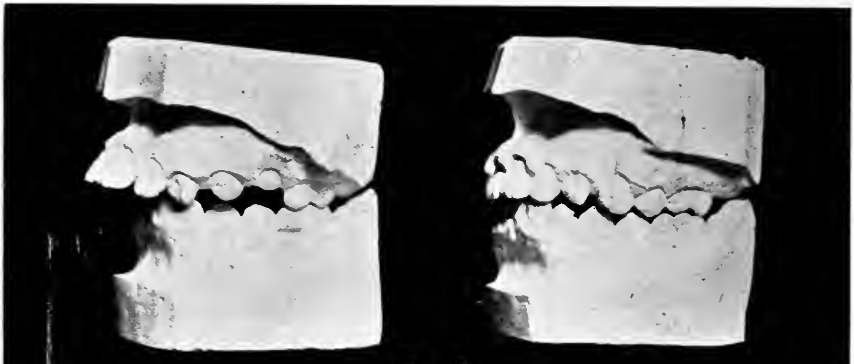


Fig. 4.

The diagnosis of this case, it being of Class I. (Angle), indicated reduction of protrusion alone in upper, and depression of incisors and elongation and buccal movement of bicuspids in the lower. The remov-

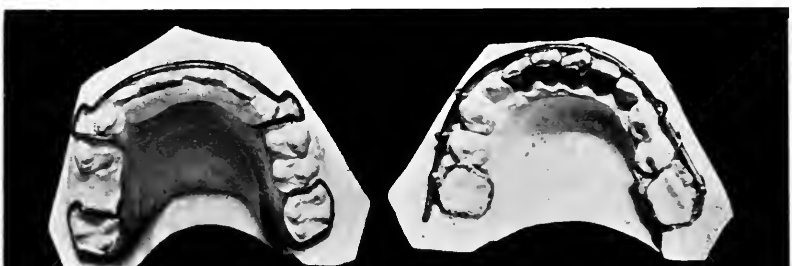


Fig. 5.

able appliance shown on cast was used on upper, and the Case stationary appliance for straightening the arch was used on the lower jaw. See Fig. 5. Both appliances were eminently satisfactorily in the positions used. The removable appliance on the upper also makes a very efficient retainer. There are a great many cases of a similar nature in which it

is advisable to use such an appliance in preference to the headgear apparatus, where the age is favorable and where the protrusion is not so extensive as to require a long operation. It possesses the advantages of inconspicuousness, efficiency, cleanliness and comfort. The models, before and after, are shown in Fig. 4.

Fig. 6.

Case III. The next set of models, Fig. 6, illustrate a case of the first class, in which a removable appliance was used to move the laterals into labial occlusion. This appliance, Fig. 7, is perhaps of no more advantage than the expansion

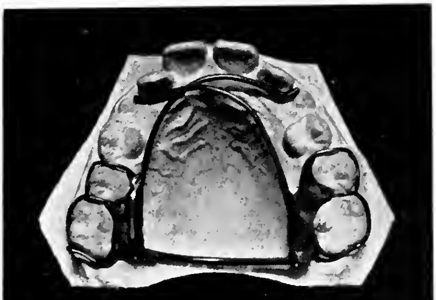


Fig. 7.

arch would be in the same case, nor as much, if we consider the time necessary to make the appliance; but if the appliance has been made by the assistant in the laboratory, time lost is not so much a factor in the case, while the inconspicuousness of the removable apparatus gives it a decided advantage over an outside wire arch of wire.

Case IV. The models illustrated in Figs. 8 and 9 show a still different combination of appliances, an expansion arch, on the upper, and a removable appliance on the lower arch, the case belonging to Class I. As the case had not been completed at the present writing, the results of the treatment

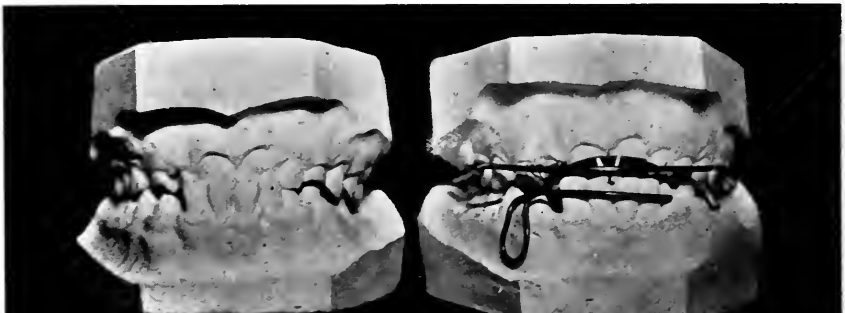


Fig. 8.

cannot be shown, but the appliances have proven efficient and satisfactory thus far.

Case V. The last set of models, Figs. 10 and 11, illustrate a case (18 years) in which it was necessary to use a re-enforcing arch on the lingual side in connection

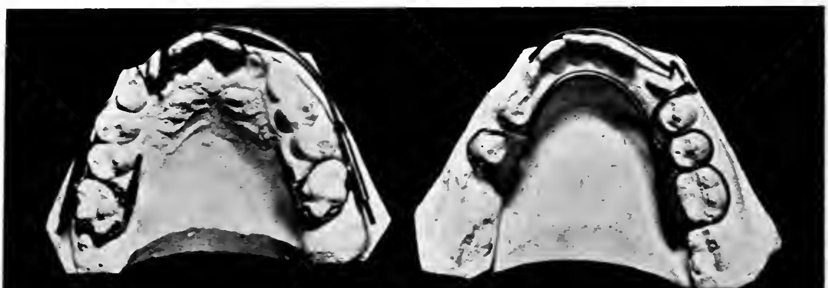


Fig. 9.

with an expansion arch on the buccal side of the upper teeth in order to hasten the operation so that it would be completed in the short time allotted for it. The inner arch is a removable appliance with spring clasp attachments (after Jackson) and it more than equalled my expectations in the results it accomplished. It is seen *in situ* on the upper cast. The

retention of this arch is a small plate touching the molars and bicuspids and provided with spring clasp attachments. The two central incisors are retained by the means of platinum gold bands soldered together and cemented in position. Fig. 11 shows the upper arch before and after treatment.

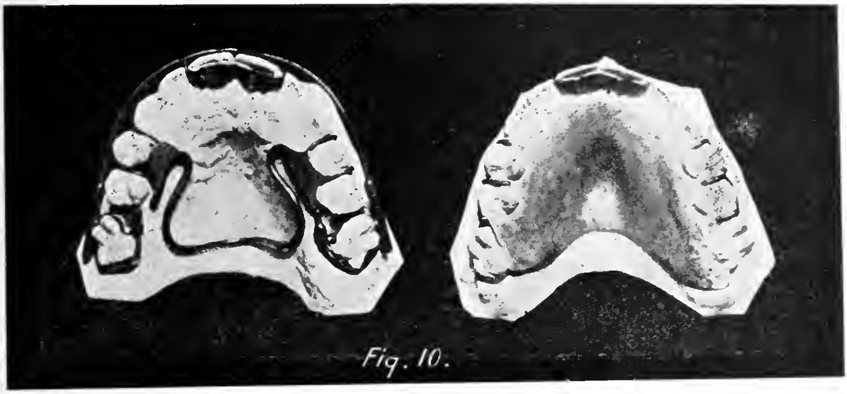


Fig. 10.

Without considering the advantages or disadvantages of either the fixed or removable appliances in general, I would state that the combinations used on the models shown were eminently satisfactory and that


Fig. 11.

many advantages may be derived from the combined use of the fixed and removable appliances, as shown in the cases presented, and the knowledge of more than one system is an added resource which ought to be of especial advantage to the orthodontia specialist, and commendable to him on that account.

Discussion.

Dr. Milton T. Watson. I have listened to the reading of this paper with considerable interest, and if it had been presented to us three years ago I would have considered it a valuable one, and the results highly satisfactory. At this time, however, I cannot endorse his treatment of the case representing a subdivision of Class II., for, with the means we have at hand now for the management of this class of cases, I fail to see any excuse for the extraction of a bicuspid. There was a time when we knew no way to manage this type of case without extracting, but as a means of correcting *occlusion,* it is obsolete treatment. The only cause for extracting, especially in younger patients, being where it is a positive facial requirement, and Dr. Pullen did not tell us that this was his reason for doing it in this case. That the occlusion would have been more nearly perfect and the apparent retrusion or depression of the anterior part of the dental arches avoided, by shifting the distal occlusion to normal, and thus retaining the full complement of teeth, is to my mind perfectly clear. Then, too, unless the lips of this patient are unusually thick there must be the same degree of depression in them that is so apparent in the dental arches.

Aside from the better results which would have been secured by the plan of treatment just referred to, there is another and a most important consideration; the necessary appliances would have been much more comfortable, and less conspicuous, in that both the traction screw and the headgear could have been dispensed with.

The plan of treatment which I believe would have served the purpose better in this case is briefly this. The shifting from distal to normal occlusion by the use of the well known expansion arch and clamp bands above and below, together with the necessary wire ligatures and the Baker reciprocal anchorage, which is the pitting of the teeth in one jaw against those of the other by slipping an elastic band over the distal end of the pipe on the D band below and over a little hook on the arch above, soldered about opposite the cuspid tooth.

Just a word in regard to the combinations of appliances shown. They are certainly an evidence of mechanical ability in so far as their construction is concerned, but our little patients' comfort, I believe, is best served by the avoidance of these magnificently complex combinations of appliances, especially those on the lingual side of the teeth and still more especially those across the roof of the mouth, for they are a source of constant discomfort as they impede every movement of the tongue both in speech and in swallowing. When we stop to consider that under normal conditions the tongue is nearly, if not quite, in contact with the

roof of the mouth we will hesitate to adopt the use of appliances which will be more or less of a restriction to the every movement of this very restless organ.

It has been too often demonstrated to need enlarging upon here, that even the most complicated cases of malocclusion can be managed successfully by simple, delicate appliances which are a source of very little inconvenience to the patient, and which allow a man to spend his energies studying and investigating the really difficult problems of orthodontia, instead of devoting his time to the designing of new and untried appliances, which at best, must be far from perfect, for a perfected appliance can be produced only after repeated trials have demonstrated the weak points of those that preceded it.

Dr. M. Dewey. It is an indisputable fact that fixation of teeth whose position has been changed is an absolute necessity for their speedy and permanent maintenance in their corrected position. Immovable appliances being the only kind offering such advantages, I deem it imperative that removable retainers be discarded.

In regard to the author's claim that under certain conditions fixed retainers invite dental caries, I wish to state that properly fitted and cemented retainers which permit cleansing of the parts involved do not predispose to decay.

And lastly I need but remind you of the innate desire of our patients to forget replacing any and all removable appliances.

Dr. Casto. My views coincide with Dr. Dewey's in respect to the removable appliances regarding the effect they might have on the teeth or the peridental membrane. I believe that the inflammation which is bound to be set up by means of a removable appliance might result in complications such as death of the pulp, and inflammation which would interfere to a certainn extent with the resorption of the process that takes place. I think also that the removable retaining appliances have the same bad features. Outside of their being perhaps a little more cleanly, I cannot see any advantage whatever in having a removable retaining appliance. However, fixed appliances as constructed today are so cleanly that that is really no objection whatever. I do not see the necessity of using a combination appliance when we know that the results can be obtained by simpler means.

Dr. J. E. Barnes. I am very glad the Doctor has presented his subject, because it has long been my desire to see what Jackson cribs were and how they operate. Personally I cannot see why there need be any great departure from the arch, since we have in it the ideal shape of the dental arch when the irreg-

ularities are corrected. When we make attachments across the mouth with these appliances, we are limited to a few teeth. However, the writer is to be commended for not tieing to one sort of appliance and with these different methods of operating we will get more real progress than we would if all were working alike. I must say that I do not like springs attached to movable appliances. They must either start irritation and inflammation, or the case must be attended to at frequent intervals; and with what little experience I have had, I find that in removing to clean, something happens to prevent the patient putting them back in place and we have trouble right away. Of course inconspicuousness is a good feature and I can see how now and then such an appliance would become commendable and useful. In noticing results obtained in the models presented, it appears to me that the doctor has not gone far enough. The incisors do not seem long enough to come down to a proper occlusion with the growth of the alveolus. If they will, I shall be only too glad to know it. In some of the cases the molars seem too long and apparently will not change much more, consequently I should be afraid of subsequent irritation, leading perhaps in later life to pyorrhoea alveolaris.

Dr. Flint. I think the essayist is to be congratulated for the care he has taken in the preparation of the subject. I believe if we have difficulty in the holding up of the retaining plate after the arch has been widened, that crib around the bicuspid might be a good thing.

As far as the removable appliances are concerned, I have not had much experience, but what few wrenches I have loaned my patients, I find when they get in front of the mirror they get them pretty well twisted and they will undo in a moment more than you can make up in two or three days. I think the less the patient does for us and the more we do ourselves, the better it is for both.

Dr. Brady. I am tempted to tell a little story which a gentleman from Kansas City has often repeated in my hearing, of a man in a certain town who always had a most charitable feeling for everybody, and which fact was well known. One time there was a man died in the town, for whom no one had a good word. Some of the people put up a job on the old man to see what he would say of the dead man. They started in to tell all the bad things they could of the deceased, saying everything they could that was derogatory to his name, and then finally turned to this man and said, "Well, what do you think of him?" "Well," he said, "he had mighty pretty teeth!" So we might say of Dr. Pullen, he has mighty pretty teeth in his models. I was inclined to think at first he had carved them out of a solid chunk of ivory, but I saw some slight imperfections in

them so I know they must be real models of real teeth. I wish to congratulate the Doctor on his models.

I feel like jumping on Dr. Pullen for his treatment in some of these cases, but then I have made some of these mistakes myself, and I believe he will know better after awhile; he will be convinced of it by his own troubles.

I once was a firm believer in putting appliances on the inside of the mouth. I would not put anything in the patient's mouth that was at all conspicuous, but my patients convinced me it was more comfortable to have the appliances on the outside of the dental arch, and Dr. Pullen's patients will convince him of this in time.

Dr. Angle. I, like Dr. Brady, wish to congratulate Dr. Pullen on his fine models. It is not every day we see such fine ones, I assure you. I have received a number of barrels full from dentists in my time, and I do not think in all that number I have ever had in my hands—at least not more than three or four—that would compare with these beautiful models that Dr. Pullen has shown us this evening.

In regard to treatment I shall have to differ with him radically. In my paper that I shall bring before you tomorrow afternoon I shall point out these differences and shall reserve what I would say until that time. I will only say here that if we could do better work with half a dozen appliances, or with half a hundred appliances, we ought to have them. It should be our object to treat cases as easily and quickly as possible, of course consistent with physiological and ideal results, and if we can do that better with a dozen different systems, we ought to have them. But if we can really do better work with only a few appliances, or with even only one appliance, would this not be far better? Do you not see how much greater skill could be developed in using but one than in using a hundred—or over six hundred, as one writer on this subject boasts that he has produced? Think on this point hard. And if I cannot demonstrate beyond the shadow of a doubt to the most skeptical man here, if he will be honest, that numbers of appliances are unnecessary and have hindered and do greatly hinder the real progress of orthodontia, I will frankly own to you that I am mistaken.

It is well known to most of you that the number of my own appliances was always few and very simple, and many have doubted whether they have been sufficient in numbers to meet all requirements in tooth movement, but I have found that even these few were too many and no longer do I make use of nearly so many in practice. In fact the more I simplify the appliances and treatment the quicker and easier am I able to treat cases, and not only do I obtain better results, but such results as

were not believed to be even remotely possible a few years ago. Many of these I shall show you tomorrow and what may surprise you more than anything else is that they were all brought about with but practically one appliance.

An appliance that I once thought to be very valuable—and so it was in its time—was the jackscrew—and I believe that I have invented the best one known to orthodontia, the simplest, the neatest, the most efficient; one that has been pirated and imitated in all conceivable ways, and one that has the greatest sale, I am told, of any appliance, yet in my own practice I have no longer any use for it; I have not used one for nearly two years. I believe that in practice it should now be obsolete, and that it should live only in history.

Of course I have no expectation that complicated regulating appliances will be abandoned by dentists. In fact the greater the number of pieces and the more complications, the better they seem to like them, and the more awe and admiration they seem to inspire. It is the very age and craze of absurd complications and numbers of regulating appliances, and the reason for this is, I suppose, because orthodontia is such a side issue with dentists and their main interests that they cannot be induced to study it with even average thoroughness, to say nothing of what its study really requires. And so, I suppose, it will continue to be until dentists can be induced to study occlusion and its requirements, of which they know almost nothing at present. Then they will realize how extremely ridiculous and absurd are the thousands of little appliances that were supposed to be so ingenious—appliances that were made to operate with a view of straightening the crooked teeth, to operate on symptoms, instead of *to correct malocclusion* in accordance with the demands of the dental apparatus as a whole and with the facial lines. There is no branch of medical or dental science that needs such complete revolutionizing in the minds of its followers as orthodontia.

But as results will speak more eloquently than I can, I will wait until my paper of tomorrow to speak further on this subject. I think if you will read between the lines you will see that it will prove what I have said.

Dr. Pullen. If one were to judge by the amount of criticism that these appliances and combinations had evoked, one could but conclude that it is the opinion of the majority of those present that removable appliances used alone or in combination with fixed appliances are of little value. Were it not that they have proven valuable to me in so many cases, I should feel somewhat discouraged about convincing any one of the fact. But I shall hope that there was enough in the ideas expressed in the paper to stimulate

some of those present to at least try some of these combinations when they feel the need or the inclination, trusting that they may be as much benefited by them as I have been.

In the first case which I presented, Dr. Watson said that he would have used the Baker anchorage and jumped the bite unilaterally. At the time this case was started, about two years ago, we were a little uncertain about this treatment, and I believed that the best results to the facial lines were accomplished by the extraction of the bicuspid and retrusion of the superior incisors. At present I should have no hesitancy in using the other method of treatment in the case, as I am doing it in similar cases presenting, with marked success.

I must differ with the gentleman who stated that removable appliances are not efficient retainers. Even Dr. Angle, who uses fewer removable appliances than anyone else I know, exhibits a removable retaining plate in his latest book.

Also, the removable appliance is not uncleanly as is popularly supposed; the very fact of its being removable marks it as the most cleanly appliance that we have. If properly constructed, the removable appliance will not interfere with occlusion unless we wish it to. The removable roof plate retainer exhibited on the last case, is not so easily displaced as the roof plate without the spring clasp attachment, and is therefore more advantageous.

In the treatment of this same case, Dr. Lourie questioned the necessity of using an inner re-enforcing arch, as judging from the model, he should say that the patient was not over twelve years of age, and that the expansion arch alone ought to have been sufficient. The fact is that the patient was eighteen years of age, the molars and bicuspids were in lingual occlusion, and as the time for the operation was limited to a few weeks, the expansion arch alone was utterly inadequate.

As to the removable appliances causing pyorrhea, I have yet to find out from the experience of others and my own that they do so, and I might give the same answer to Dr. Casto's query whether or not the peridental membrane was affected by these appliances.

Some of these cases are incomplete, as unfortunately it was impossible to finish all the cases I wished to present at this time; hence I can show the results to date only in one or two of the cases.

From the remarks of Dr. Brady and a few others I infer that they have misunderstood my paper to the extent that they believed that I was working entirely with the removable appliances, or at least gave them the preference over the fixed appliances in all cases. That is not the impression I intended to convey, as I have only spoken in this paper of special cases in which I deemed it advisable to use them alone or in com-

bination. Experience is a valuable teacher, and if she has taught Dr. Brady many years ago that removable appliances are obsolete and never to be used, she has taught me the opposite lesson, that there is a place for removable appliances and retainers where the fixed appliances are not so advantageous.

I wish to thank the gentlemen who recognized the great amount of work necessary to prepare and mount the models and appliances for this exhibit and expressed themselves in such a kindly manner. I thank you for the attention you have shown my paper as evidenced by the discussion.

Malocclusion of the Teeth Among the Ancient Peruvians.

By Alton Howard Thompson, D.D.S., Topeka, Kan.

The ancient inhabitants of Peru, before the Spanish conquest, were a most interesting group of people. They had developed a high civilization for their times, even when compared with Europe at that date, and were in many ways superior to the cruel and greedy conquerors who destroyed their civilization and who robbed them, not only of their gold and silver, but of a happy and well ordered life.

On the lofty plateau between the Andes on the east and the Cordilleras on the west—whose feet almost rest in the Pacific ocean—at an altitude of 10,000 feet and more, there was developed a most unique and perfect civilization. The government of the Incas was patriarchal and beneficent and reached every department of the life of the people, and controlled the action of every individual from the cradle to the grave. Under the pressure of peculiar conditions and limited means they developed a social and industrial system that modern socialists might envy and the apostles of economic organizations might study with profit and admiration. It was a thoroughly organized communism, and as a social organism it was perfect. The Incas and their numerous descendants were the aristocracy and filled all the offices, both civil and military, but the people were mildly governed and provided for with patriarchal care. The rule of the Incas was in marked contrast with that of the cruel Aztecs of Mexico, on account of its humaneness. Their industry was phenomenal. They left immense architectural structures that fill the river valleys of the coast and the lofty plateaus, that are the wonder of the archæolo-

gist. There was a grandeur about their personal and national life that makes all the sadder the ruin wrought by the heartless conquerors.

The ethnology of the ancient Peruvians is rather difficult to make out. The empire was very heterogeneous in the palmy days of the Incas, as it was made up of many various tribes which had been conquered and absorbed into the body politic, but with little assimilation. The Quichuas were the dominant race, from whom the Incas sprung, who had the superior ability and culture, and they it was who developed the wonderful civilization of ancient Peru upon the high plateaus starting from Cuzco, the City of the Sun. The Quichuas were of small stature, of clear olive brown complexion, and their osseous structure is as fine and delicate as that of the better class of Europeans. Their conquest, however, included the large and strong Aymaras of the Titicaca region, who yet constitute a distinct group from the Quichuas. The latter extended their conquest down to the coast and were dominant in the river valleys that crossed the desert between the Cordilleras and the Pacific ocean. The Quichuas of the Inca classes, both on the plateau and on the coast, were a delicate, highly civilized people, and the Aymaras of the plateau were coarse, large and strong. The two groups have different anatomical characteristics which are well shown in their remains. The dental peculiarities are also quite distinct in many respects.

The Skulls of the Quichuas.

The skulls of the Quichua Peruvians found in the tombs are usually small, or medium in size, round or brachycephalic, with a tendency to bulge at the occiput. The Aymara skulls are larger. The forehead is narrow and receding and the glabella and superciliary ridges not prominent except in the coarse Aymaras. The jaws are light and orthognathous, prognathism not being prevalent in the higher types at least. But the natural form of the skulls is rarely found in the tombs for the reason that artificial deformation was practiced to an extraordinary degree by these remarkable people. There were apparently various styles of shaping the head for the purpose of being fashionable, for it differed in different parts of the country. As Prof. J. Wyman says (Peabody Museum Rep.):

"The Peruvian crania present the two modes of artificial distortion, those from the chulpas or burial towers of the district of Lake Titicaca being lengthened, while those from nearly all other localities are broadened and shortened by flattening of the occiput."

The early writers, as Morton, Blake, Wilson and others, supposed these elongated skulls to be natural, and only examples of excessive dolicocephalic form. They did not think it possible to artificially produce such symmetrical elongation. Besides, they thought that it would affect

the intellectual faculties. That children often succumbed to the cruel custom is evidenced by the number of young crania that are excessively elongated. These elongated skulls are found principally in the Aymara district, and it is supposed that this tribe first inaugurated the custom, and it thence extended to nearly all the region of the plateau and down to the coast. But along the coast the fashion of compressing the skull was different. The head was flattened from forehead to occiput, as if between boards, so as to project greatly at the parietals. This was the style at Pachacamac, Ancon, and other coast places. This form is quite like that of the Flat-head Indians and other tribes of the northwestern coast of North America. The bulging of the parietals is very marked, and is not always symmetrical, but often "lop-sided," so to speak. One side apparently got the better of the other and soon became beyond control and bulged permanently more than the other. A deep valley often ran over the parietal suture between the bulged sides. M. D'Orbingy observes (Pritchard, Nat. Hist. of Man, 2,604):

"In the flattening of the frontal bone, in the projection that it forms over the bones at the upper part, there has evidently been compression before and behind, which has forced the mass of the brain backwards by pushing, as it were, the frontal bone over the parietals. There is also obliteration of the sutures at all points affected by the pressure, even in the heads of the youngest subjects."

Effect of Compression on Dental Arches.

Our interest in these compressed crania is to observe whether the custom had any effect upon the form of the jaws. We might expect that the effect of the distortion of the bones of the cranium would affect the position and articulation of the upper maxillary, at least, and cause deformity of the arch. But this was not observed in any of the compressed skulls examined. The arch was full and normal and of beautiful outline in nearly all that had full dentures. Neither the elongated nor the flattened forms seem to present any deformity that might not have arisen from congenital causes. There were deformed jaws, of course, and some of them were associated with the artificially compressed skulls, but it was not apparent that the deformity could have been in any way connected with nor due to the compression.

The writer, in the course of some investigations being prosecuted in regard to the ethnic variations of the teeth, examined about five hundred skulls of the ancient Peruvians in various museums of the United States. While this is not a great number from which to make deductions, they may be considered as fairly typical and representative, and the averages would not be affected much by the examination of a larger number of skulls.

Teeth of Peruvians. The teeth of the ancient Peruvians present some general characteristics that must command our attention. In the first place, having an advanced civilization, we find some corresponding effects on structure due to environment, as might be expected. Observations made on the skulls show that their civilization and luxurious surroundings, such as they were, had an effect upon the jaws and teeth resulting in disease, deformity, irregularities, missing teeth, contracted jaws, delicate bones, etc., among the better classes. The writer was reminded that we would need to remodel again our concepts in regard to the effects that civilization has had upon the teeth. A half century ago it was quite the fashion to assume that savage and prehistoric peoples had better teeth than civilized nations, and all because they lived closer to nature and ate coarser food. Then some extensive investigations carried on in different countries on savage and prehistoric skulls disclosed the fact that there was much dental disease and deformity among them, and the pendulum swung too far the other way, so that is where we are today. But in the presence of the disease and deformity exhibited by the cultivated Peruvians we will evidently need to remodel our theories again and return in a degree to the ideas of the pioneers of fifty years ago. This, of course, with some modification as to the prevalence of defective structure and disease as between savage and civilized nations. Here we have an ancient people but one with considerable culture and living in luxury. Indeed they lived a more artificial life than their European conquerors, and were infinitely superior to them in the altruistic provisions of their social and economic organism. We are bound to believe that the artificial, luxurious life of the Inca classes did have a degrading effect upon the oral structures, and induced disease and deformity. These conditions are very marked, and when we consider the luxurious and sensual lives they led, we cannot but assume that there was some connection between degenerate structure and degrading environments. Of course the lower classes there, as elsewhere, present a stronger structure, unaffected by luxury and vicious living—not that they are entirely free from disease and deformity, but they present less of it. So we deduce that among the civilized Peruvians, as elsewhere, the higher stage of civilization and vicious living, accompanied by the environments of such an artificial life, induced and led inevitably to degeneracy of structure and tissual maldevelopment, and that this is especially manifested in the jaws and teeth.

So that it is with especial interest that the writer made observations and notes of the Peruvian skulls in reference to the quantity and quality of malpositions of the teeth, abnormal jaws, etc. It was a most interesting

study to find here, among an ancient people, the results of degeneracy due to high living and luxury.

The general results of these examinations may be epitomized as follows:

The Dental Arch. Malformations of the arch occurred, but they were not very numerous. Compression at the bicuspids, extending even to the extreme form, called the "saddle-arch," was the most frequent form of derangement. "V-shaped" arches were not so common as the saddle-shape. These deformed arches were not associated apparently with artificial compression of the skull, exclusively, although they were found with it. The famous compressed skull of the Inca, described by Dr. Dorsey, with the very irregular and defective teeth, is one of these. One case of V-shaped arch was flattened from the central to the first molar on the right side. Of course grossly deformed arches were not common, the usual malformation being the slight contraction due to crowding of the teeth or to occasional absence of teeth, as in the case of missing laterals. As a rule the arches were round and full and of fine shape. In the coarser jaws the arch was more square, due to the prominence of the canine, as in all square arches.

The Upper Incisors. A form of malposition that occurred with singular frequency, among the Peruvians, was the eversion of the upper centrals inwards at the mesial borders. Some such teeth were rotated as much as one-fourth of a circle, but the majority only slightly. This often resulted in the destructive wear of the mesial corners. The distal face was sometimes completely turned outwards, thereby overlapping the laterals which were crowded under them by the contraction of the arch. Sometimes, but rarely, the centrals were everted outwardly at the mesial line, and very rarely overlapping at this point. The alignment of the centrals was not often disturbed, unless by contraction of the arch, which was not common. The most common malposition was the eversion of the centrals at the mesial borders. The upper laterals were next in frequency of malposition, sometimes everted outward at the mesial side and overlapping the centrals, but this was rare. The lingual malposition was most common—articulating within the lower incisors, and the upper centrals and canines overlapping it by contraction of the arch. Occasional rotation of the laterals occurred in greater or less degree.

The Lower Incisors. The lower incisors were frequently out of alignment, standing within or without the line of the arch, with consequent contraction and overlapping. The laterals were frequently caught behind the canines and held by contraction of the arch. Slight eversion of the centrals inward at the mesial bor-

ders was quite common. Irregularity of these teeth to only a slight degree of misplacement was not uncommon.

The Upper Canines. The upper canines were quite frequently rotated, usually by the distal angle being turned outwards and overlapping the bicuspid. Sometimes they were turned one-fourth round, the buccal face being presented mesially. Of course the canine frequently stood partially or entirely outside of the line of the arch, which was contracted at that locality. This form of malposition was not infrequent. Occasionally they were erupted within the line, but this type was uncommon. This form seemed to be due to the causes with which we are only too familiar, i. e.—articulation within the lower teeth, and consequent contraction of the upper arch.

The Lower Canines. The lower canines were occasionally erupted within the line, but the usual form of malposition was without the line, sometimes the full width. Rotation similar to the uppers sometimes occurred, but it was not so common.

The Upper Bicuspids. The upper bicuspids exhibited a remarkable amount of malposition. Being rather small in size, as compared with those of Europeans (which the writer found to prevail in most American races), they seem prone to displacement, as if they were not able to resist the erupting force of the stronger canines and bicuspids. But be that as it may, the bicuspids among the Peruvians were the subjects of an unusual amount of disturbance. They frequently stood without or within the line one-half to all the width of the crown. Bicuspids erupted entirely within the arch were not uncommon, the arch being entirely closed up. Some were found impacted in the bone, not having been able, apparently, to erupt for want of room. The crowns were frequently rotated, also, one-fourth to one-half of their circumference, the buccal and lingual faces being transposed. This unusual type was far from uncommon.

The Lower Bicuspids. The lower bicuspids were subjected to the same disturbances and frequently stood outside of the line one-half to all of their thickness. The crowns were sometimes rotated to a greater or less degree, but not so frequently as the upper bicuspids.

The Upper Molars. The upper molars exhibited some degree of disturbance, being frequently slightly out of line and sometimes to one-fourth of their width. No excessive malposition of the molars were observed, except, of course, in the third molars, which presented all the ordinary types of malposition with surprising frequency. In the saddle-shaped arches the first molars, both above and below, stood out of line, or perhaps the contraction of the arch

at the bicuspids left them in normal position. The upper first molars were not infrequently slightly rotated.

The Lower Molars. The lower molars were but rarely out of line and still more rarely rotated, except, of course, the third molars, which were frequent subjects of disturbance, as much so as with Europeans.

Supernumerary teeth were found, but yet were not common—scarcely the same percentage as among Europeans. The most frequent of these reappearances of suppressed teeth was the third incisor above, which was usually located lingually of the median line between the centrals. It sometimes disturbed the centrals by pushing the median angles outward. In one case the third incisor was fused to the lateral. Rarely the positions were transposed, as when the canine and first bicuspid changed locations. Supernumerary bicuspids and molars were very infrequent, only one or two of these cases being observed. Suppression of the upper laterals sometimes occurred. Such a case is described by Dr. Geo. A. Dorsey of the Field Museum. (*Cosmos,* 1897, p. 213.) This is to be expected in a race which exhibits so many of the stigmata of degeneracy.

Excessive irregularity in which nearly all of the teeth were the subject of disturbance was not common, not nearly so frequent as among Europeans. But the presence of malpositions of the teeth indicated the tendency to degeneracy that was so apparent in many respects among the Inca classes. It was interesting to observe that even among this ancient race integrity of structure and normal development of the teeth and jaw was, like modern civilized peoples, in inverse ratio to the progress of culture and luxurious living.

Discussion.

The Chairman. It is very interesting to know that these people of that far off time had irregular teeth, but I would like to know whether there were any orthodontists in those days, and if so, what their methods were. It occurs to me that it is unfortunate that we still need to have such descriptions of the malpositions of the teeth. If the essayist had only studied them and classified them, and we could know how many belong to one class and how many to another, it seems to me it would have been of far greater value to us. I regret that that was not done. We do not know from that description whether they were mouth breathers; whether they exhibited the usual conditions we have to contend with nowadays or not, and I shall be glad when the time comes that scientists adopt modern classification or something better, so that we can understand it.

Dr. Kemple.

I should think to attribute the deformities of the ancient Incas and Peruvians to a very high degree of civilization and luxurious living, would be hardly in keeping with the investigations of the most recent historians. I just noticed recently in reading one of John Fiske's histories of the discovery of America, speaking about the degree of civilization that the people of this continent had reached before the Europeans came here, he said the highest degree of civilization had only reached what we know as barbarism; that among the Incas,—in fact from the Esquimau to the Patagonians—there were no people who had advanced beyond barbarism; that our idea of the luxurious civilization existing among the Incas and ancient Aztecs is not correct, showing, I should think, that it could hardly be argued that luxurious living and a high degree of civilization resulted in degeneracy. I do not know what the essayist's authority is for saying that the Incas were far in advance of the Europeans of that time, but it is certainly not in accordance with recent investigations.

Variation in Human Dentition.

By John Humphries, M.D.S., Birmingham, England.

The dentition of typical mammals is represented by the formula:

$$\text{In. } \frac{3-3}{3-3} \quad \text{C. } \frac{1-1}{1-1} \quad \text{P. M. } \frac{4-4}{4-4} \quad \text{M. } \frac{3-3}{3-3} \quad \text{Total } 44.$$

This was characteristic of the beasts of the Eocene period, whose clumsy bodies and low intelligence were unfitted for the time when the struggle for existence became more intensified, and so we find the mammals, of the succeeding Miocene and Pliocene times, more specialized in body and limb, with greater cranial capacity, and teeth diminished in number, but well adapted for their altered environment.

Dentition of Beasts.

Hence in studying the teeth of existing creatures, we must bear in mind, that they are the result of evolution, extending backwards over an enormous period of time, and they tell the story most eloquently of the successive stages of their existence, and how by the loss of one tooth and the modification of another, they have been able to hold their own and survive to the present day.

We see illustrations of this in the wart-hog where the enormous

development of the canines has effected a reduction in the molar series, which in the adult animal is represented by In. 3, a tooth of abnormal proportions, all the premolars and molars having been removed.

The absence of incisors and canines in the upper jaw of ruminants is explained by the link supplied by the guanaco and camel, where a pair of rudimentary incisors occupy the inter-maxillary bone and in close proximity are a pair of small canines.

But the dichodon and the dichobune, which were probably the ancestors of the ruminants, and existed in Eocene times, possessed the archetypal formula, all the teeth being present in both jaws, without break in the series. The molars possessing the selenodont characteristics of true ruminants.

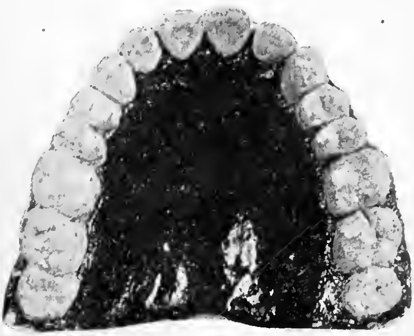


Fig. 1.

Fig. 2.

The functionless first premolar in the horse, which is lost in early life, is suggestive of its descent from the eohippus, in which the premolars and molars were of brachydont patterns with short roots, and when in course of time they assumed a hypsodont type, the first premolar became gradually more and more degraded, and seems likely to disappear altogether in the modern horse.

The dentition of the bear is fast being reduced by the degradation and loss of the premolars, and in many domestic dogs, as the pug and the bulldog, the third lower molar is often missing.

The tiny pair of teeth behind the scalpriform incisors in the hare and the rabbit also testify to the elongation of its jaws to the specialization of the remaining pair, which alone occupy the intermaxillary bone in the rodents, the other two parts being suppressed by loss of room and disuse, one pair still persisting in the group, leporide, in a rudimentary form, illustrating the evolution of the rodent.

Dentition of Man.

Human dentition is represented by the formula,

$$\text{In.}\ \frac{2-2}{2-2}\quad \text{C.}\ \frac{1-1}{1-1}\quad \text{P. M.}\ \frac{2-2}{2-2}\quad \text{M.}\ \frac{3-3}{3-3}$$

showing a loss of a pair of incisors and two pairs of premolars in each jaw, and this is true likewise of all the higher apes.

In examining the skulls of a great number of domestic dogs some years ago, I was much impressed by discovering in ten per cent of the cases, the missing third upper molar, either in a rudimentary condition, or enclosed in its crypt, restoring it to the archetypal formula of the amphicyon, the probable ancestor of the canidæ, and I forthwith determined to accentuate as much evidence as possible on the missing teeth in man. Part of the result of my labor was a joint paper by my col-

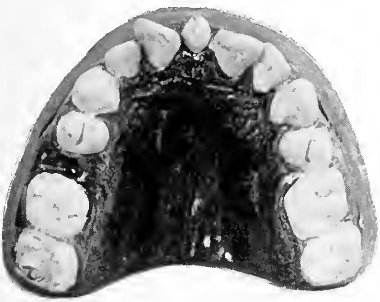


Fig. 3.

Fig. 4.

league, Professor Windle, and myself, on "Man's Lost Incisors," read before the British Association in 1886 at their meeting in Birmingham, and since that time I have steadily collected casts bearing upon the subject, and when your president, Dr. Angle, did me the honor to ask me to read a paper before the American Society of Orthodontists, I determined to send you my notes upon a matter which has greatly interested me, illustrating it with photographs which have never yet been made public.

Dr. Charles Tomes states that "if we wish to find an absolutely typical human dentition, we should go to the lower races," in which generally the teeth are well formed and arranged in sweeping curves, with no sign of irregularity or lack of symmetry.

If we compare Fig. 1, the upper jaw of a typical Zulu, with Fig. 2, a well-formed European, we should see at a glance the difference in size of the teeth, the greater sweep of the curve in the Zulu, together with the increased alveolar development.

But it is quite unusual at the present day to find perfect symmetry in the higher races of mankind, due to the decreased and decreasing size of the maxillary bones, brought about largely by disuse, from the more thorough cooking of food, and the consequent atrophy of muscle and bone, from imperfect mastication, and hence we meet with an ever increasing number of irregularities of the teeth.

Another factor in the lack of symmetry is caused by the presence of additional teeth beyond the normal number, more usually found in

Fig. 5.

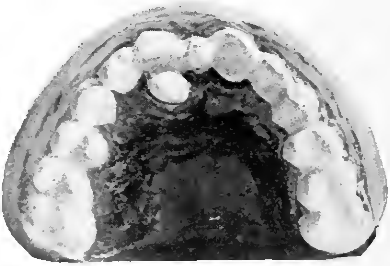


Fig. 6.

Fig. 7.

Fig. 8.

the incisor region, and may be divided into two classes, supernumerary and supplemental.

Supernumerary teeth are usually of a conical form, though some bear faint traces of cusps. Teeth in a state of degeneration generally assume a conical shape, such as the upper wisdom and lateral incisors in man, which in many mouths appear as cone-shaped pegs. The third lower molar in the dog and the whole of the molar series in the aardwolf of South America, which feeds upon carrion, are reduced to simple cones; therefore it would appear that prior to total suppression teeth revert to

the conical shape. Generally speaking the other teeth are more or less disturbed when supernumerary or supplemental teeth are present.

Fig. 3 shows a conical supernumerary erupted in the median line, twisting the right central and slightly displacing the left central.

In Fig. 4 the supernumerary tooth has also appeared between the centrals, pressing forward the right central.

Fig. 5 is an illustration of one of the commonest forms of supernumerary teeth being produced in the palate behind the left central incisor, in no way interfering with the arrangement of the teeth.

Fig. 9.

Fig. 10.

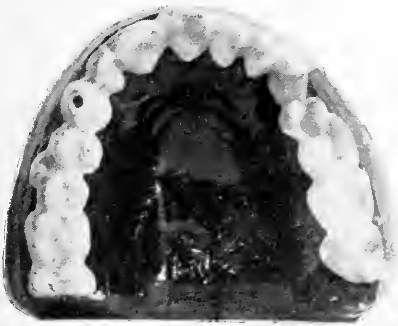


Fig. 11.

Fig. 12.

In Fig. 6 is seen a pair of conical supernumeraries, the one occupying the median line between the incisors which it has forced apart and the other behind the right central.

Fig. 7 shows a contracted upper dentition, further distorted and crowded by a pair of conical teeth, behind the central incisors.

In Fig. 8, a conical supernumerary appears behind the left central incisors, while the right side is much disturbed by a supplemental incisor, which has erupted in the median line, and displaced the right central and lateral incisors and the canine.

In Fig. 9, a pair of supernumeraries are pressing outwards the central incisors; they are of unusual form, having minute cusps upon their surfaces, giving them a slight molariform appearance.

Supplemental teeth in every respect imitate the lateral incisors, both in shape and size, and it is almost impossible in many cases to say which is the normal and which the additional tooth, so close is the resemblance.

Fig. 10 shows a supplemental incisor behind the central, but the symmetry of the teeth is not affected by its presence.

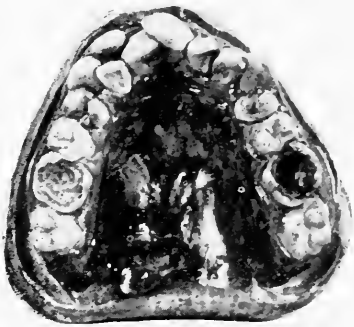


Fig. 13.

Fig. 14.

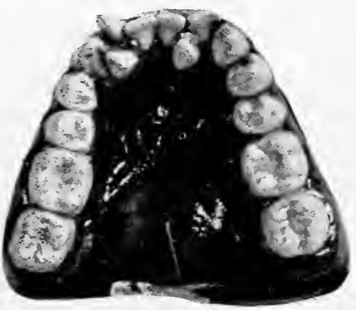


Fig. 15.

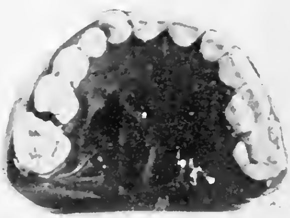


Fig. 16.

In Fig. 11 an additional incisor is present on the left of the mouth whose presence would hardly be suspected, as it is in line with the others, which are not displaced or twisted.

Fig. 12 exhibits a supplemental left incisor in lower jaw in line with the others, but the canine has been pushed outwards by the additional tooth.

Fig. 13 suggests a return to the archetypal mammalian dentition in the upper jaw as six incisors are present. On the left the supplemental

tooth stands side by side with the lateral incisor, but on the right the teeth are considerably displaced by the additional tooth which has erupted behind the lateral incisor.

In Fig. 14 the front teeth are considerably distorted, the centrals being forced wide apart by the presence of a pair of supernumerary incisors, which from lack of accommodation are twisted at right angles to the front of the mouth.

Fig. 15 shows a pair of supplemental incisors in the lower jaw which have appeared behind the normal incisors and mimic them in every respect.

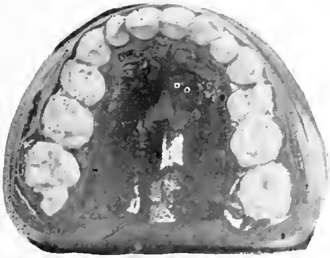


Fig. 17.

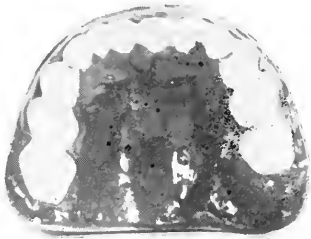


Fig. 18.

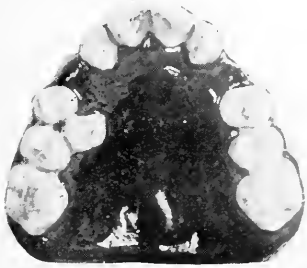


Fig. 19.

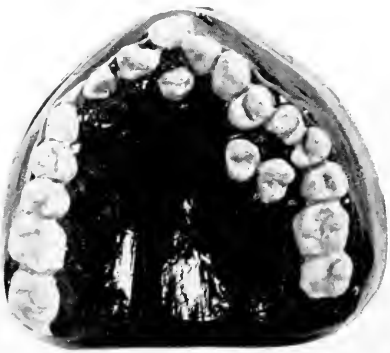


Fig. 20.

Supplemental teeth are by no means confined to the permanent dentition, for in Fig. 16 we notice a deciduous supplemental incisor on the right side of the mouth in line with the others whose presence would pass unsuspected as the other teeth are perfectly symmetrical.

In Fig. 17 an additional deciduous upper lateral incisor is present on the left side of the jaw, and like the last, it has not disturbed the other teeth, and it is interesting to know that this tooth was succeeded by a supplemental lateral incisor in the permanent set.*

*See editor's note at end of this article.

Fig. 18 is an extremely interesting deciduous cast, in which may be seen the missing pair of upper lateral incisors side by side with the others, **a return** to the typical dentition In. $^{3}.^{3}$ and the jaw has accommodated itself to receive the additional teeth.

Supplemental Premolars.

The evidence of the missing premolars is extremely scanty, as compared with the incisor region, but Fig. 19 shows an additional right upper bicuspid erupted in the palate, between the two premolars, bearing a strong resemblance to the first.

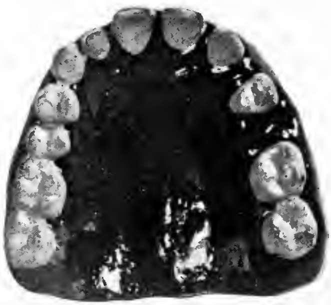


Fig. 21.

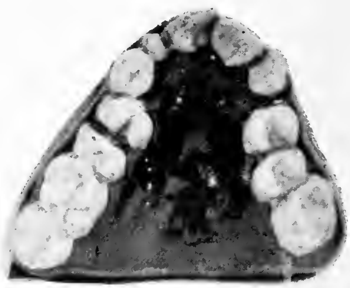


Fig. 22.

Fig. 23.

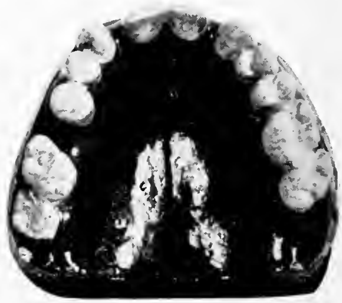


Fig. 24.

Fig. 20 is, however, the most extraordinary cast I possess, exhibiting eight premolars in the upper jaw, six occupying the left side of the mouth, four standing side by side, though rather crowded, the two others being produced inside the palate and differing but little in size and shape from one another.

The foregoing remarks illustrate "Variations in Human Dentition" due to the presence of supernumerary and supplemental teeth, but there are others due to the degradation and final suppression of the teeth,

more especially the lateral incisors and the upper wisdoms, third molars, which interfere with the symmetry of the teeth. This is a marked characteristic with many families and occurs more frequently than we imagine.

The first indication is in the diminution in size of one or both laterals, which after a time assume the conical form and then one and ultimately both are suppressed, the incisor dentition being represented by the central incisors only.

Fig. 21 shows the right upper lateral stunted and dwarfed. The upper left is missing.

Fig. 22 illustrates a saddle shaped palate in which the teeth are crowded, the right lateral being reduced to a conical peg, while the left is absent.

Fig. 25.

Fig. 23 shows a corresponding loss of one incisor in the lower jaw, and this, like many others, was an inherited characteristic.

Finally, in Figs. 24 and 25 we have the suppression of both lateral incisors.

Conclusions.

We may then adopt the following conclusions:

1. That the conical supernumerary teeth which appear sometimes singly and at other times in pairs in the intermaxillary bone are degraded forms of incisor teeth.

2. That in both upper and lower jaws the missing incisor teeth are occasionally reproduced, either singly or in pairs.

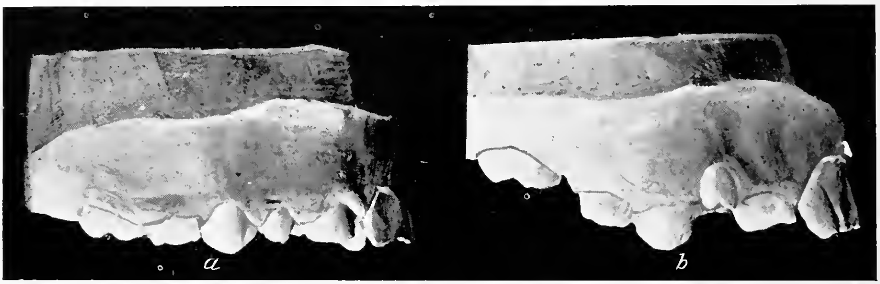
3. That the deciduous teeth possess the same characteristics, and when present the symmetry of the mouth is not affected and the milk tooth is sometimes succeeded by a permanent supplemental incisor.

4. That one or other of the missing premolars occasionally reappears and bears a strong resemblance to the normal bicuspids.

5. That there is a tendency to a diminution in size, and a degradation in shape to a conical peg of the lateral incisors and upper wisdom teeth.

6. That in civilized man, the lateral incisors will probably ultimately disappear.

(The illustrations A and B, from casts in the editor's collection, are introduced in corroboration of the author's statements in relation to his Fig. 17. Fig. A shows an additional deciduous lateral incisor, and Fig. B is from a later cast of the same mouth showing its successor in the



permanent set. In both instances the teeth were normally well formed. It is of interest to add that the child was born with hare-lip but no cleft palate.—Editor.)

Discussion.

Dr. Tittig. In considering the paper, without seeing the photographs, I fear the essayist has attributed to a decline in the race what we attribute to inheritance. For instance, I know that in my own family the laterals in a number of individuals have never appeared. In two of my sisters the laterals were lacking, and in one of my daughters, so that I consider that as much a matter of inheritance, as the case of a man I saw with two fingers united, who claimed that there was always one such deformity in the families for generations back. I think the essayist has taken some family type and misinterpreted that as a retrogression of human dentition. However, you know it has always been claimed that by environment people or ani-

mals change; for instance, if it was necessary for the rabbits to climb the fences of Australia to get into the gardens, that they would grow nails for that purpose. But I have never been able to see anything of this character otherwise than as a family inheritance.

Dr. Weeks. There was one statement made by Dr. Humphries that I think was successfully contradicted yesterday by Dr. Cryer, in speaking of degeneracy from high living; that is, the gradual loss of the teeth. In one of Dr. Cryer's slides made from a recent specimen, he called that to mind. I think it is well to remember that. It is rather encouraging to feel we are not degenerating as rapidly as many of our profession would have us think.

Dr. Brady. It is of course difficult to discuss properly a paper of this kind, in which the essential part is pictures that unfortunately we cannot show; but as I have given some thought and study to the subject of supernumerary teeth and how to account for them, I will say a word, especially as the paper touched upon a point on which I am doubtful. It has always seemed to me that to account for supernumerary teeth by saying they are a reversion to a remote ancestral type is a very far-fetched reason, involving such vast periods of time as to be very doubtful. It is supposed that man has existed as man, organized practically as he is at present, anywhere from twenty thousand to thirty-five thousand years.

It may be interesting and perhaps surprising to know that upon some section or other of the earth to-day there are representatives of every race and degree of civilization from the earliest days of the cave dwellers up to the highest civilization of the European and American people. There are tribes existing at present that are utterly ignorant of the use of fire; who cannot build a shelter from the storm with even the material furnished them; who have progressed so little from primitive man as not to be able to use utensils as well as the ordinary ape; and from this low condition we have every intermediate grade up to the highest civilization; yet so far as I have been able to gather from the skulls I have seen and from the study of others, the lower races possess the same number of teeth as the higher races. We cannot go back far enough among any living representatives of the race, even among those tribes that are living but little differently from their ancestors of prehistoric days, to find a regular appearance of the third incisor, or the premolars that have been lost from the complete formula.

So then, for the teeth of man of the present day to revert back to the days of a third incisor, or third and fourth premolars, the reversion must go backward over immense periods of time to the days before man was man as we know him; possibly hundreds of thousands of years. It has al-

ways seemed to me that there is some reason much nearer home than this. But after reading the paper and seeing the pictures, it certainly seems that these teeth are in some way connected with the past, and heredity seems a stronger trait than I had given it credit for; it seems all the more so as the author has not confined himself to the teeth of man, but has taken the subject up in a broad, scientific way.

I hope to secure a paper next year from one of the most eminent zoologists in the State of Iowa—or in the whole country for that matter—on this subject, illustrated by slides, and showing not only the teeth of man but the teeth of other animals as well, and illustrating how far the effect of heredity can be traced in the teeth through the ages. Anything he presents will be convincing, for besides being learned, he is a most careful and painstaking man, and what he says can be depended upon to be correct. I hope this paper, when it comes, may throw some light on this subject that has perplexed us all.

The Retrusion of Both Jaws With a Single Appliance.

By Rodrigues Ottolengui, M.D.S., New York.

The object of this brief paper is to place on record a principle in relation to the management of double prognathism, which I have not elsewhere seen discussed by specialists in the field of orthodontia. Briefly stated, it is that, in many cases, especially where the treatment is begun early in the life of the subject, no appliance is needed upon the lower jaw, it being possible to so form the apparatus for the upper jaw that the lower arch may be simultaneously retruded; in some instances, as in the case which I shall report, the upper natural teeth may be made to serve as an inclined plane which will carry the lower anterior teeth backwards; in others, as where the reduction of the upper arch is conducted with the mouth bit and skull cap, the mouth bit may be made to act as the inclined plane. There will, of course, be still other cases where the lower teeth will require special apparatus.

Classification. Before giving the details of the case which I desire to present, I beg the privilege of asking for some light upon the modern doctrine of classification. It seems to be the generally accepted view that all cases of irregularities may be made to drop into definite sections of a prearranged classi-

fication. I have no doubt that this is true. Dr. Angle has given us such a classification, and I am in accord with his scheme of making the fundamental principle an investigation of the occlusal relations. By the majority of practitioners the Angle classification has been indorsed as being entirely comprehensive. At the last meeting of this body, however, Dr. Ernest Walker questioned this fact and expressed the view that in addition to considering the occlusal relations of the teeth, if classification is to serve as a basis of adopting a scheme of regulation, it might be wise to add to this a study of the relation of the jaws to the physiognomy. Otherwise, he claimed, we must have cases in a stated class which nevertheless would require diametric modes of treatment. This view appears so logical that it has seemed strange to me that no formal expression of opinion upon Dr. Walker's proposal was made at last year's meeting.

Premising my remarks by admitting that I cannot claim to fully comprehend what the language of either Dr. Angle's or Dr. Walker's classifications mean, and thereby admitting that either or both may be entirely correct, and that it may be my own ignorance both of language and of orthodontia which creates my mental puzzlement, I ask permission to make my criticisms, explaining that I do so for my own enlightenment and not for the purpose of belittling the work of others.

The case which I am to present to you today is one in which the occlusion in the posterior regions is practically normal. In relation to the physiognomy the anterior portions of both jaws are prognathous. Analyzed, this means that the upper incisive region is protrusive in relation to the upper part of the face, while the lower incisive region is protrusive in relation to the chin; the forehead, nose, and chin are in normal physiognomic relations. I do not find myself able to place this case under any section of either the Angle or the Walker classification.

A word more and perhaps my difficulty of comprehending these gentlemen may become apparent. The object of language is, or should be, to convey thought; in scientific matters the language should be direct and readily comprehended by even young students of the science to which the language is supposed to contribute. Now I find that in describing the occlusal relations of the jaws, both Angle and Walker have adopted the terms "mesial" and "distal." They also use the hyphenated term "mesio-distal," which my mind fails to grasp with certainty. The best that I can make of this is, that by "distal" is meant the posterior part of the mouth, and perhaps this may serve. By mesial is meant the anterior, or more definitely speaking, the incisive and cuspid region. But this is only guesswork on my part, for the word "mesial" does not have any such meaning. "Mesial" means towards the median line or center. More strictly, it means at the center. Thus, if I am told that the jaws are "nor-

mal in their mesial relation," I have a right to conceive that I am told that the median lines of the two jaws are coincident, a fact which often is not true, and which then becomes an important factor in the correction of the abnormality. If it be true then that in these classifications the word is not meant in its true significance and has no bearing upon the median line, but is used to indicate the forepart of the mouth, I respectfully submit that we should better follow the rules of surgery and employ the term "proximal" as the antithesis of the word "distal." In general surgery "proximal" means that portion of the subject nearest to the observer, and distal that point farthest from him. In regard to the hyphenated term "mesio-distal," I ask, What is meant? The combination being new to me, and I think not heretofore used by any author, I can only seek analogous language for its elucidation. In describing tooth surfaces we have, for example, used the term gingival in relation to

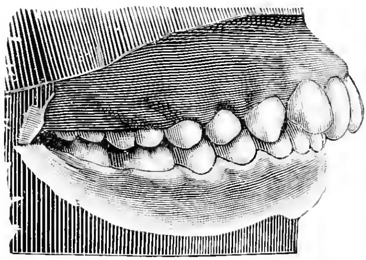


Fig. I.

approximal cavities, to indicate that part nearest to the gingiva. From this we have the compound word "bucco-gingival," which means that point where the buccal surface meets the gingival portion of the approximal surface. Similarly we have linguo-gingival. Does mesio-distal then mean that part between the distal and the so-called mesial, let us say the cuspid region? I think the term is meant to convey the idea that would be more accurately expressed by the words "mesial" *and* "distal," supposing that mesial is to be used at all. "Proximal and distal" would be more intelligible. It is true—and I mention this to forestall the use of the fact as an argument—that some authors speak of "disto-approximal" cavities. But such use does not make the language correct. It should better be written distal approximal, for the idea to be conveyed is that the cavity is both distal and approximal, terms which are in no wise contradictory. Mesio-distal, on the contrary, is the union of antithesis. If the whole occlusion is meant, the hyphenated contradictory terms are superfluous. It should suffice to say "occlusion normal."

Case from Practice. Admitting then that I cannot classify my case, I herewith submit it for your consideration. The patient presented with an irregularity as shown in the models. (Fig. 1.) I have so trimmed the upper and lower edges of these models that in the one the line of the base of the nose and in the other that of the chin is indicated. All forward of that represents protrusion, the child exhibiting a horrible pouting mouth. This, coupled with the irregular placement of the teeth and the parting of the lips, which exposed them constantly, created a great deformity. A study of the models showed the arches to be of normal width, and the posterior, or, if you please, the distal occlusion, normal. The necessary course, therefore, was extraction of the four first bicuspids and reduction of both arches. My first purpose was to have operated on both jaws simultaneously, using

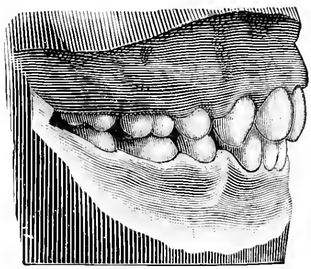


Fig. 2.

a fixture on each. The depth of the overbite, however, led me to believe that something would be gained by carrying the upper teeth back to some extent first, lest the upper cuspids hinder the backward movement of the lower cuspids. I therefore constructed an appliance for the upper arch. This consisted of a roof plate made of iridio-platinum held by clasps around the molars. To these clasps were attached the Jackson retraction wire crib, and the work was begun. By the time when the gain in the upper jaw was appreciable, I noted that the lower jaw was being simultaneously corrected, the overbite being sufficient so that the upper incisors acted as an inclined plane which carried the lower teeth backwards. The case was therefore completed with this appliance, no instrument whatever being used on the lower. The final models (Fig. 2) indicate the present condition, and show how completely the space made by the removal of four teeth has been obliterated. The irregularity of the central and lateral, observable in the casts, is slight and less apparent in the mouth than in the models. A better result was not sought in this

locality because of an accident. The retrusion of the upper arch to some extent also regulated these two twisted teeth, much more so than would have been suspected at the outset, except by one who has had similar experiences. The retrusion being completed, steps were taken towards the rotation of the teeth, and this had been nearly accomplished when a child companion struck the little patient in the mouth with a Fourth of July horn, and so injured a tooth that I feared death of the pulp. It being then almost time for the summer vacation, I applied a retaining fixture. In the autumn the parents decided that the result was sufficiently satisfactory, in view of the interruptions of school attendance which would have been required to fully complete the work. This, however, is merely

Fig. 3.

an aside, the models being exhibited as an example of double retrusion and not as bearing upon the regulation of ordinary irregularities of individual teeth.

A word in relation to the fixture utilized. In cases where I decide to work entirely within the mouth—that is to say without resort to the skull cap—I always feel that the roof plate is desirable as a help in avoiding the tipping of the molar anchor teeth. For this reason, even though I may utilize the Jackson retraction crib, I attach it, as in this case, to the clasps of a roof plate. I have found, however, that the bending of the front retraction wire from time to time, as is necessary to increase pressure, will cause a tipping of the forepart of the plate, so that it is removed from contact with the roof, thus preventing the very use for which it is constructed. With great care, of course, the wire can be so bent that the adjustment will be accurate, but, in my hands at least, this has often been a time consuming detail. More recently, therefore, I have found a means of obviating this difficulty, and the plate which I exhibit

(Fig. 3) will demonstrate this, though it is not the plate that was used in the case under discussion. In such cases now I add to the buccal sides of the clasps small staples and the retracting wire, instead of being soldered to the clasps, is attached by a curved loop passing through the staples. In effect this method of attachment operates as a hinge, and thus the bending of the front wire in no way displaces the roof plate. I have found by experience that the loop on the ends of the wire should be large to allow free play.

I wish to add that this case was regulated five years ago and that the final models were taken during the present summer. At the outset I stated that similar results might be obtained when the use of the skull cap is considered the proper treatment. This I based upon two cases that have passed through my hands—one successfully completed some years ago and the other still under observation. In these cases the mouth bit is made to extend over the incisive edges of the upper teeth, and an inclined plane is attached to the lingual surface thereof, care being taken to make it long enough to certainly engage the lower teeth.

In all these cases the treatment must largely depend upon the extent of the overbite. Where the overbite is short, it will be necessary to attach the inclined plane to the upper fixture, because otherwise the locking of the natural teeth will be insufficient to carry the lower teeth back. Again, progress must not be too rapid. It must be remembered that the greatest strain will be upon the upper teeth, which, if the work is pushed, will be retracted so rapidly as to cease to engage the lower. It may, therefore, become essential to resort to periods of rest, the inclined plane improving the occlusion and retracting the lower teeth, while the upper teeth remain stationary. Also, I must advise that especial note be taken of the direction of the lower incisors in relation to the alveolus. If they be erect, the procedure will be safe. If, however, they tip labially, meeting perhaps in an edge to edge bite, or with but slight overhang of the upper, it will be necessary to begin work upon the lower with a separate fixture, retracting the incisors until they assume an upright position, after which perhaps they may be carried back with the upper fixture.

Discussion.

Milton T. Watson. I believe Dr. Ottolengui's whole trouble, and that of some others who seem to be confused by Dr. Angle's classification, is due to the fact that they do not understand that it absolutely separates, for the time being, the teeth from their surroundings and considers them only in their occlusal rela-

tions. It applies as completely to the plaster teeth on a model as to the natural teeth in the mouth surrounded by the distorted face. It covers an abnormal condition of the teeth, but does not apply in any sense to abnormal facial lines, though, of course, certain types of facial deformity must and always do result from some certain classes of malocclusion. It is the position of the teeth, however, and not that of the face which governs one in classifying the case.

Class I. is described as a condition in which the molars and bicuspids are in normal mesio-distal relation—that is, these teeth are on the normal side (in their mesio-distal relation only) of the crest of the cusps of the occluding teeth, but they may be in abnormal relation to them bucco-lingually, or they may, perhaps, be perfectly normal in both of these relations and yet be in abnormal relation to the "line of occlusion," and the incisors may be in any of the seven possible positions of malocclusion. This, I think, will make it clear why Class I. falls far short of *normal occlusion.*

Regarding the objection to the terms "mesial" and "distal." Those who are teaching this classification make it perfectly clear what they mean by "mesio-distal relations," but if it can be shown that "anterior" and "posterior" are really better terms—that they convey to the average mind a clearer conception of what is meant—then I am sure every one of us stands ready to adopt them. These terms, however, have nothing to do with the vital principle upon which this classification is based.

Dr. Ottolengui. Will you classify this case?

Dr. Watson. It is a case where one might easily be mistaken if he based his opinion upon a hasty examination of the models, as the teeth, on one side particularly, have almost an end to end occlusion. A careful examination, however, reveals that the cusps of the various teeth in the molar and bicuspid region are still occluding on the normal side of the crest of the cusps of the teeth in the other jaw, which clearly places the case in Class I.

I would hesitate to say positively that wrong was done in extracting in this case—not having had a chance to examine the patient. One might venture an opinion from a careful study of photographs, but the face itself affords the best opportunity for a study of this phase of the work. I believe there are a *very few* cases coming under the head of Class I. where, to attain the best facial results, the sacrifice of an upper and lower bicuspid on one side would be necessary. However, cases requiring the extraction of four bicuspids must be *exceedingly rare.* The extraction of an upper and lower bicuspid from one side only, of course, carries the median line of the dental arch slightly to one side of the median line of

the face, but if the cuspid and incisors, on the side from which teeth were not removed, are carried lingually sufficiently to give the arch its natural curve, the inharmony existing between the median line of the face and that of the teeth will not be noticed, so that the argument, sometimes advanced, that "symmetrical extraction" is necessary does not hold true.

The classification presented by Dr. Walker, a year ago, has been referred to. He endeavored to so arrange a classification that it would include the abnormalities of the face in their relation to those of occlusion. This, of course, made the subject a very complex one, upon which even the men who could comprehend it would ever differ, for even artists differ in their opinions as to what represents beauty and perfect harmony in the human face.

The classification of malocclusion of the teeth and the classification of facial deformities are separate and distinct conditions and can best be studied as such, for to attempt to combine them only brings confusion to both, while, if considered apart, we can all agree upon the one touching upon occlusion even though we ever differ upon the other.

Dr. Ottolengui. I really wish to comprehend this. I did not attack the principle; I started out by saying that I absolutely endorse the principle. Nothing could be more definite than my statement that classification based upon occlusion is a perfectly proper theory. Neither did I intimate that the words anterior and posterior are preferable to distal and mesial, except as I comprehend them. I have never understood it as presented by the last speaker, and if I comprehend it now I think it would be a great mistake to use "anterior" and "posterior." I think "mesial" and "distal" would be absolutely correct. I have never been able to get any one to explain this before, and now let me be sure that I do understand it. In this system, the terms mesial and distal refer to the occlusal relations of the cusps of the posterior teeth, more particularly of the sixth year molars, and have no bearing upon the anterior teeth, nor their occlusion. Is that right?

Dr. Watson. It is.

Dr. Ottolengui. Now that I understand it, I am willing to admit that "mesial" and "distal" are exactly the right terms.

Dr. Brady. While the subject of classification is up for discussion, I shall try to elucidate one point further. We may speak of the position of the jaw as mesial or distal, or anterior or posterior, or by any other name we see fit, and yet mean the same thing. Dr. Ottolengui has said it was hard for him to

understand how we may take a certain case and drop it in a certain class, just as we would drop a peg in a hole.

Dr. Ottolengui. I did not say that.

Dr. Brady. Possibly I misunderstood. But the point I wish to make is that we may call these different classes by other names than Class 1, Class 3, or the subdivision of division one in Class 2, and so on. (The Doctor here referred to charts on the wall, showing the different classes and subdivisions.)

It is my habit in speaking to students of a case to refer to it as a case of retrusion or protrusion, instead of belonging to Class 2 or Class 3, and instead of saying it is division or subdivision this, that, or the other, I say it is a case of retrusion on one side or retrusion on both sides, or protrusion on one side, as the case may be. I express exactly the same thing as is meant by Dr. Angle in his classification, but in different language, and refer to the condition by its name instead of its number.

Most of these gentlemen here have studied under Dr. Angle, and to them the number brings to mind the condition, though to others the name might suggest it more clearly. The mental picture of a thing is what we really recognize it by; the name we give it depends upon the way we have studied it; names may differ, but if the condition meant is the same, the end is the same. So we may refer to either Class 2, or retrusion, or to Class 2, division one, or retrusion of both sides, as we may see fit, and yet mean the same thing.

I would say further that in speaking of malocclusion of the teeth we consider the position of the lower jaw in relation to the upper as a whole, not in relation to one or a few teeth. In studying a case the first thing to decide is whether the lower jaw as a whole is normal antero-posterially, or is retruded or protruded, moved backward or forward, anterior or posterior, mesial or distal—any of the names mean the same thing.

I have quarreled with Dr. Angle—I want Dr. Ottolengui to know we are not all of one mind on some things—I have quarreled with him over the words mesial and distal, believing anterior and posterior to be better; but, as Dr. Watson has said, it is only a difference of name, not of condition.

Dr. Barnes. It seems to me we are starting a Tower of Babel here, when one talks about Class 1 and Class 2, and subdivisions, etc., and another talks about cases of protrusion and retrusion, and so on, and they all might mean the same thing. I think Dr. Bogue hit the nail on the head when he said we are putting it into algebra. Now, it seems to me that the classification should

be a sort of synopsis of what is to come afterwards. It should be a short definition, self explanatory, so that when we take up a subject, immediately the thought is conveyed to the listener of what the person is talking about. To my mind, this classification of Class I, and subdivisions, etc., conveys no meaning whatever. I am not at all attracted by that terminology. If the Doctor will give us a word instead of a class, it will mean the same thing. It will make the thing a little more complex, perhaps, but ought we not to have a terminology that will be accurately expressive? It is all right for one school or one system to have classes and subdivisions, because men who have learned in that school can understand it, but if others cannot, how can we go ahead? We should all agree on this one point. I am not competent to suggest a nomenclature, but I suppose such a thing is possible.

Dr. Monroe. Since I have made a study of this work I have found it very much like a musical scale. The simplicity and beauty of it is so apparent, that I fail to see how those who have been in dentistry longer than I have, can fail to comprehend these terms as used.

I have always, ever since I made a special study of the branch associated with occlusion, that special line of occlusion upon which we base all our terms, so that when we speak of the line of occlusion, we get a very good idea of where the cusps should fall and in what position they should range themselves.

I have never been satisfied to speak of the different occlusions of the two jaws. I think that the occlusion should be confined to the one jaw that is movable. If we speak of the distal occlusion of the upper jaw, and mesial occlusion of the lower jaw in reference to the same case and vice versa, we are just confounding terms. The upper jaw is fixed. It cannot be moved, consequently the occlusion cannot change in that, except as related to the lower jaw. It applies only to the position of the lower teeth and for that reason it has appeared very simple to me and the beauty of the classification is more than apparent to me.

The Chairman. It seems to me that we have not quite treated Dr. Ottolengui right in this matter. We have been confining our discussion to classification. He has brought us an interesting case here and nothing has been said about his method of treatment and the many points he has brought out in regard to the treatment of the case. It may be very instructive to others and it seems to me that those points ought to have been discussed and some appreciation shown for his efforts in the treatment of that case. If any one has any comments of that character we will be very glad to hear them.

Dr. Bogue. I did not hear the paper, but I saw the models. I hope next time the Doctor will bring models open at the back so that we can see the case better. I think if hinges were put on the extreme sides and the models left entirely open in the middle a good view could be had of the occlusion on the lingual sides.

I think I have never seen a case in which extraction has been practiced where the resulting occlusion when the case was finished seemed as good as this does, judging from the outside. No one can tell whether there has been much rotation or not, but externally it looks as though there had been much less rotation than usual, and, as I said before, a better outside occlusion I have never seen where extraction has been practiced. But unless the patient had a marked deformity of countenance due to the protrusion of these teeth, and unless the patient was an adult, I don't see how Dr. Ottolengui dared take out those four bicuspids.

Dr. Ottolengui. What would you have done?

Dr. Bogue. "What was the age of the patient?"

Dr. Ottolengui. Twelve years.

Dr. Bogue. I should have thought that the patient should have twelve more years of growth, waiting until more matured to see what the contour of the face should be. I should think with that added growth—Nature never makes a mistake—there would have come development anterior and posterior as well as over and above and downward as was evidenced in the case passed around yesterday, to such an extent as to harmonize the features with the teeth, which had their forms before eruption of the size which belongs to the adult individual. Previous to six years of age the permanent teeth, or the crowns of the permanent teeth, lie in the infant's skull of the same size that they are going to be at forty years of age. They lie in a condition of regular irregularity. There is not room for them to be regular. The central incisor teeth lie forward of the lateral incisors. In all baby skulls, unless there has been some accident to disturb the regular irregularity, the bicuspids are up in the jaw and the cusps have hardly begun to form and they are entirely outside of the line. That is what I mean to say, that those teeth are as large at that period of development as they ever will be. That child is not as large by any manner of means, the skull is not as large and the face is not developed anteriorly, nor has the skull developed posteriorly as much as it will.

I will tell you a story. I was at the circus one night in Paris. My assistant was with me, a young lady who lives with my family. This young lady pointed across the circus and said: "I venture to say that

those two young ladies over there are Americans." She looked a little longer and said: "I think both of them have lost their sixth-year molars." They were in my office within a week and they *had* lost their sixth-year molars, being Philadelphians. There is a non-professional view of it, across a building with two utterly unknown people. It is not at all difficult to detect this mutilation, as a rule. The young woman had stood beside my chair for ten years, and had seen people with these teeth gone.

Dr. Ottolengui. I asked you what you would have done with my case?

Dr. Bogue. I would enlarge the arch sufficiently to get proper occlusion of the first permanent molars to begin with, for upon them rests the permanent regularity of all the teeth in the mouth.

Dr. Ottolengui. The molar occlusion was correct at the outset.

Dr. Bogue. I would enlarge the arch of the six front teeth. I would spread the ends of the bow a little further apart. In the first place I would draw forward the incisors until the edges of the lower incisors were arranged like the stones in an arch, touching at the edges and not allowing any portion of the central part of the tooth to overlap another. I would build an arch that would not go down under pressure of the lower lip, and in getting that arch, if it were necessary to advance the upper ones, I should do that. When I got through that at twelve years of age, I would see that the lower teeth were held in their proper positions. I would put nothing on the upper teeth at all, so soon as the bicuspid occluded properly, knowing that the lips would draw sufficiently to keep the upper teeth against the lower teeth where they belong. I would hold the lower ones in position, being perfectly confident that the upper ones could never get out of that position so long as the proper occlusion admitted of the cusps going into their relative places. Unless the patient were a mouthbreather and slept and went around with the mouth open. I should calculate that when adult life were reached there would be a dignity of countenance, as Dr. Angle not very long ago expressed it, a strength of countenance, that never can be had where there is loss of dental tissue.

Dr. Ottolengui. I want to say that for the proposition which Dr. Bogue has made for the regulation of these teeth, I excuse him, because he has not seen the patient—it is the most awful proposition I have as yet heard, for the correction of the malformation of a mouth. I have distinctly said that the child came to me with an extreme protrusion which pouted the lips. He tells us to carry the teeth further out, widen the upper and lower jaw and make

everything more prominent than ever, and then hold them so that they cannot get away, and trust to Providence to cure the protrusion that he has increased.

As to classification, I wish to say that even with my ignorance of Dr. Angle's classification, I classified it correctly. I put it in Class 1. The occlusion mesio-distally—I adopt the terms because they are right as I understand them now—is normal. Therefore, all talk about correcting the molar teeth is time wasted.

Dr. Bogue. I made no allusion whatever to the molars, because you said they were right.

Dr. Ottolengui. You first said you were going to start by making the molars right, and you had seen the models. I say I put this case in Class 1, consequently I realized that the occlusal relation of both jaws in the molar and bicuspid region was already normal. They were not only normal in the occlusal relation, but they were normal in the physiognomic relation.

I had no such trust in Providence as Dr. Bogue has. I did not believe that the face would be built out, and now, five years later, no such development has occurred. Even so, I cannot see that any increase of the size of the arch would have been necessary. The overbite is just as great in the beginning of this case as it was in the end. I do not believe that by moving the teeth out you would have brought the chin forward.

I agree with what has been said as to the extraction of bicuspids. I do not think I have extracted a dozen in my life. I do not extract until I am driven to it. Before I have extracted, I have often tried regulation first and carried it to the extreme limit before removing the teeth.

Another point I wish to make: Whatever classification we may adopt, I think if the anterior portion of the mouth is in a symmetrical condition and does not present a bad appearance, we would have no patients to work on. They come to us, not because of any scientific irregularity of their teeth, but because of the apparent irregularities.

I want to allude to the fixture I have used. Much has been said in the journals and other places against the roof plate. I wish to call attention to the fact that my roof plates are made of iridio-platinum and that they are not used during mastication, being removable; consequently there is never, practically, any opportunity of the food getting on them, under them or around them. This plate was worn all last winter. I brought it purposely without boiling or polishing it. It was much more presentable when first made, but still, you see, it is clean, because it is boiled every day; the direction to the patient is that it shall be boiled in a soda solution every day.

I have a patient for whom I retracted an upper jaw at the age of eight to ten years. She is now seventeen years old and is still wearing the retaining appliance. It has been to a certain extent a director for the eruption of the new teeth to compel them to come in properly. That little lady has been constantly under my care. I have had occasion to put but two small gold fillings in her teeth and these where there was no fixture, in the lower teeth. The necessity of keeping a retainer clean teaches the patients cleanliness, so that a fixture that can be boiled every day is an advantage rather than a disadvantage to my patients. I thank you all very much.

Art in Relation to Orthodontia.

By Edward H. Angle, M.D., D.D.S., St. Louis, Mo.

Mr. Chairman, Members of the American Society of Orthodontists and Friends:

I wish this afternoon to try to interest you in a very important phase of the science of orthodontia—that which regards the lines and contour of the face from the standpoint of art, and the bearing which our work has upon the molding or modifying of these lines. I trust there is no one here so devoid of art as not to realize that the mouth is a most potent factor in making or marring the beauty of the face, and also that the teeth to a very large extent are responsible for the form, character, and beauty—or the lack of it—of the mouth. No one can be beautiful unless the mouth is in harmony with all the other features, and no one suffering from malocclusion of the teeth can have a mouth that is thus in perfect harmony.

Our duties as orthodontists force upon us great responsibilities, and I know of nothing in which the orthodontist should be more keenly interested nor better informed than in the study of the artistic proportions and relations of the features of the human face, for each of his efforts, whether he realizes it or not, makes for beauty or ugliness; for harmony or inharmony; for divinity or deformity. I confess that the feeling of great responsibility has often weighed upon me as I have begun the treat-

ment of many of my patients. You who are close students of orthodontia well know the far-reaching results of the bungling errors of the incompetent upon the occlusion of the teeth, and were you as well versed in callesthetics you could as readily detect the defacing effects of these same bungling errors on the distorted lines of the face.

As orthodontists we must ever place foremost in importance the normal occlusion of the teeth, for only in normal occlusion is their greatest usefulness and beauty possible. But many of our patients would never

Fig. 1.

reach us were it not that the malocclusion of their teeth produced inharmony in the lines of their faces, and from this marring of the facial lines they come to us seeking relief. If our efforts are intelligently directed, we can do far more to render plain or even distorted facial lines pleasingly symmetrical, or even beautiful, than any one else who has to do with the human face. Indeed the changes which may be wrought by intelligent effort on the part of the orthodontist are often marvellous and almost incredible, and I hope to show you before I am through that they may also be equally efficacious in producing or enhancing ugliness and deformity if unintelligently directed.

But in order that our efforts may be intelligently directed towards the ideal what rule, what principle shall guide us? If there is not some grand principle as a basis from which to reason, we must be but gropers

in the dark, experimenters, with results which may cause embarrassment or even bitter regret.

We know that while human faces are all greatly alike, yet that all differ; and for years I sought to find some line or measurement which might be applied in any given case by which to detect these differences, and especially the abnormalities in individual cases, and from this basis to direct my efforts toward fulfilling the requirements of art. But no line, no measurement, admitted of anything nearly like universal application.

Fig. 2.

The line which applied so well to the Apollo face was wholly out of the question in gauging the harmony or inharmony of a very large percentage of other faces; and in despair I one day asked a great instructor in art, Mr. Edmond H. Wuerpel, what line this was, "for surely," I reasoned, "artists who make portrait study their life's work must know." To my great surprise he answered: "There is none. Such a line as you seek has been sought for by many, but it is not even possible." "Can this be true?" thought I. "Were Raphael, Murillo, Rembrandt, Van Dyck, Michael Angelo, and such great masters content to work without a basal line when even crude artisans, as masons and carpenters, have one?" But if it were true, I could understand why my long search for the magic

line had been so unfruitful. Then I asked: "If there can be no fixed line, can you not tell us some way of determining what is wrong in the lines of our patients' faces, that we may intelligently direct our efforts towards their improvement?" And he said: "Yes. It must ever be judgment as to *correct proportion of the features in each given type.* That is, the nose, the forehead, the chin, the lips, must all be in correct

Fig. 3.

proportion, in balance one with the other, and this will vary in each type and in each face. This power of correct judgment of proportion and balance seems to be a gift possessed by only a very few. Doubtless all may cultivate it to a certain extent, but I am convinced that not more than one in two or three hundred will ever master it, and even these must develop this judgment by close study in drawing and modeling, and in observation."

I confess this was discouraging to me as a teacher. Was it possible that only one in two or three hundred orthodontists would ever be able to develop that fine judgment so necessary to bring about the high ideals

in results for which we all so ardently longed? I have no doubt my artist friend is correct. My subsequent reading on this subject confirms this belief. Yet notwithstanding this, I believe we do have a rule which artists probably know nothing of, and one more unvarying and more reliable than even the judgment of the favored few—a rule so invariable and with so few exceptions that we may almost consider it a law, and if it be not applicable in all cases, the exceptions will be so rare that they are hardly

Fig. 4.

Fig. 5.

worth considering. It is, furthermore, a rule so plain and so simple that all can understand and apply it in each case. It is that the best balance, the best harmony, the best proportions of the mouth in its relations to the other features require in all cases that there shall be the *full complement of teeth, and that each tooth shall be made to occupy its normal position.* And if we accomplish this we shall have satisfied the demands of art so far as they are concerned in the relation of the mouth to the rest of the face.

I know this will surprise you who are familiar with the literature of orthodontia, in which extraction has been so lavishly advocated. How often have we read that in the treatment of cases of malocclusion extrac-

tion was resorted to "to prevent the lips being made too prominent," or, that "the requirements of art necessitated that I remove such and such teeth," or that "the patient inherited the large teeth of one parent and the small jaws of the other, making extraction necessary for the art requirements as well as those of occlusion."

Having inherited, as it were, these sayings, I also naturally believed them, but I am now positive that they are wrong, without substantiation, and that they ought to be abandoned, and that working from these dic-

Fig. 6.

tates must be followed by asymmetry of the face, which is perhaps only the least of the evil effects.

These conclusions have not been arrived at hastily, and I wish to offer as evidence a large number of cases which represent not the easiest, but the well-defined or most difficult cases belonging to all of the different classes and sub-classes of malocclusion, or in other words, evidence which embraces the entire range of types and sub-types.

Some of the pictures which I shall show were used in illustrating other points relating to orthodontia in a lecture which I gave last Tuesday evening before the Institute of Stomatology in New York and which will be published in the *International Dental Journal.* They will be here shown to tell chiefly of the story of art.

The first picture, Fig. 1, shows a face of much beauty and fine proportion, and the point that I would emphasize is that such proportion and such beauty can only exist where everything is in harmony—normal throat and nose relations, normal development of the bones and muscles, and normal occlusion of the teeth. Had one tooth been sacrificed during the development of this face we could not have such beautiful contour. Or had but a single tooth been sacrificed after the full development of the face these beautiful lines must soon have been marred from the inevitable tipping and malocclusion, which always follows the loss of a tooth unless it be

Fig. 7.

immediately artificially substituted. Such perfect proportions and such fine lines are rare, among modern mortals at least, but I insist that the principle will hold good, that the full complement of teeth is essential to the best proportions, be the lines *fine or otherwise.*

Fig. 2 shows normal occlusion, without which, as we have said, such a face as is shown in Fig. 1 is impossible.

The next two pictures, Figs. 3 and 4, show lines of wonderful contrast. Those of the face of Apollo are supposed to be faultless in proportion and to typify beauty, and yet what a marked contrast with the lines and proportions of the other face (that of Wm. Whipple), which I believe to possess far greater beauty, for it seems to me that not only are the proportions of this remarkable face in equal balance, but that it possesses in addition intelligence, strength, majesty.

We might with profit study a large number of other faces of fine proportion, but we must hasten to a consideration of those faces in which, by reason of malocclusion, the mouth is thrown out of harmony with the other features.

Here is another face, Fig. 5, familiar to you all. In addition to naturally fine proportions there shines out a kindness and gentleness in this face which has made this man so lovable, and yet how all is marred and thrown out of harmony by the mouth, evidently through the loss of teeth necessary to give it proper contour and proportion.

Fig. 6 shows another face which has many of the elements of beauty, and yet I am sure that none of you who have made anything like a close study of this subject can fail to readily detect that the mouth lacks much

Fig. 8.

in proper contour—the result of the loss of teeth. Were the full complement of teeth present, that depressed upper lip would have a much more pleasing contour; the deep line from the nose to the angle of the mouth would be far less pronounced and the angle formed by the nose and the upper lip would be less obtuse and much more pleasing and in keeping with harmonious proportions of the face.

Fig. 7 shows the face of a boy fourteen years of age, and you will note how lacking in proper contour is the region of the mouth. This lack in the facial contour will impress you more when you remember that at this age a boy's mouth should be more prominent in proportion to the rest of the face than that of the adult, but upon reference in Fig. 8 to the excessive malocclusion the reason for this lack of normal contour becomes

apparent. There is very pronounced crowding of the teeth, both upper and lower, and, as must naturally follow, lack in the development of the alveolus, for this can only be developed in accordance with the positions of the teeth. This is a case in which I would have thought a few years ago that extraction was positively necessary to the requirements of both art and occlusion, and it has taken a long time for me to feel sure, as I now do, that in all such cases extraction is emphatically contraindicated.

Fig. 9 shows the face of the same boy three years later, and you will note how greatly the contour of the face has been improved and how

Fig. 9.

much better the balance of proportion has been established. The reason for this is made clear by reference to the next picture, Fig. 10. The teeth have simply been placed in normal relations and retained until the development of the alveolus, so long arrested by reason of the malpositions of the teeth, could be completed, or, more correctly, had been allowed to "catch up" in its growth with the other bones of the face. Had one tooth been sacrificed (to say nothing of four bicuspids, or even of six bicuspids and one first molar, as I have recently seen in a case submitted to me in

consultation), the result would certainly have been most noticeable in the resulting lack of proper contour of the mouth.

Fig. 11 shows the profile of a boy aged eleven, and you will all doubtless say that the lips are already too prominent, and that to expect to correct his pronounced malocclusion, shown in Fig. 12, without extraction would seem to be to greatly augment the prominence of the lips, spoiling the balance of proportion and even creating an unsightly deformity. But you will see that even in this remarkable case the law that I would like to establish holds good, for in the next picture, Fig. 13, there has been made ample room in the arches for the teeth when placed in normal occlusion and the facial lines have not been made worse, but, on the contrary, greatly improved, as shown in Fig. 14. Who can place a money value on such an improvement?

Fig. 10.

I could show you a large number of other cases belonging to this class of malocclusion (Class I), and they would all prove the correctness of my theory. Indeed I cannot look back over all the long list of my cases without feeling that I have made blunders, at least from an artistic standpoint, in the cases belonging to this class in which I have extracted teeth, except possibly in one or two, and even these are debatable.

Here is one case, Fig. 15, in which it may have been an error to have retained all of the teeth. It was so decided by Prof. Wuerpel who says that the lips have been made too prominent, and this is the only case that he has so criticised. Now we can see reason for his criticism for the lips in Fig. 16 are perhaps overprominent to be in best balance with the rest of

the features, but even in this case I believe that I am right, for let us remember two conditions existing here: First, while the teeth are developed to full size, the development of the rest of the bones of the face is far from completion, and the nose, the forehead, the chin, will all be different at maturity and in far greater harmony with the present sizes of the teeth. Second, the lips in this case are temporarily over-developed by reason of a habit frequently contracted, especially in nervous patients—that of working the lips more or less constantly on account of the presence of the appliances in the mouth, thus tending, as with all muscles, to increase in size

Fig. 11.

with increased exercise. But when the cause is removed they speedily return to their normal size. I have seen this in a number of cases. So I believe that in five years the correctness of the theory will be proven also by this case. If possible I shall at the proper time again publish the picture of this face.

Fig. 17 illustrates another case from which we may learn many valuable lessons. We need be but superficial artists to readily detect that the mouth in the face on the left is greatly out of harmony with the rest of the features. The lack of proper contour is so pronounced as to possibly create the impression that all the teeth may have been lost and that the lady is wearing badly proportioned artificial dentures. But the real

cause of the deformity is readily determined by a study of the condition of the teeth, shown in Fig. 18. It is due to bad dentistry—to the perpetuation of an old and very pernicious theory among dentists, namely, the effort to prevent malocclusion by the practice of early sacrificing the four

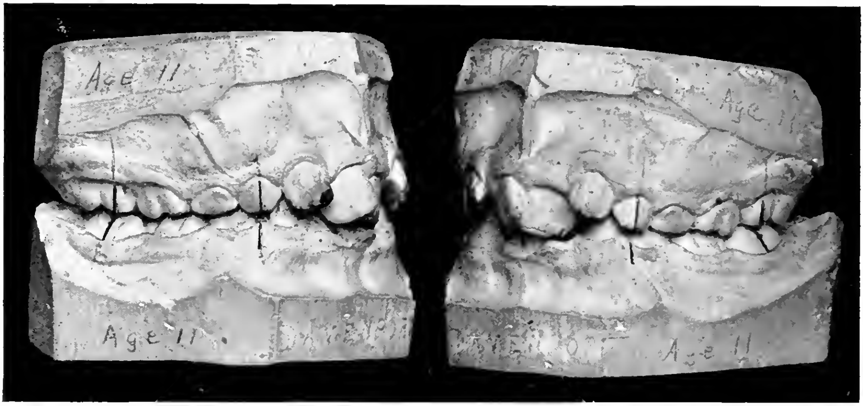


Fig. 12.

Fig. 13.

first molars, which in this case were removed at the age of nine years, though perfectly sound. The result shows what an unfortunate blunder has been committed in the name of science, and how seriously the occlusion and facial lines have suffered. It is remarkable how such practice could ever have gained standing among thinking, reasoning men of our profession.

You will note that the incisors both upper and lower are retruded, and the tipping of the other teeth is so pronounced as to destroy the

normal relation of all of their occlusal planes. The lack of contour of the facial lines was but the natural result of the loss of these teeth. The teeth anterior to them could not be pushed forward in accordance with the requirements in the development of the alveolus to its full normal size. In other words, there was an arrest in the development of the alveolus, with a corresponding effect on the facial contour, which is so apparent in the profile.

I hope that all those who lightly sacrifice the first molars will study well the result of such practice, as shown in this case, for this is not an

Fig. 14.

unusual result, but an unvarying one. It is a law that I have never yet known to act differently, the only modifications being due to the age of the patient—the earlier it is done, the more far-reaching the evil effects. The teeth that remained were in this case practically useless for mastication. The only rational treatment that I could think of was the restoration of each tooth to its normal occlusal position and the replacing of the lost teeth by artificial substitutes. The result of this treatment is shown in Fig. 19, where the case is ready for the expert bridge or plate maker. The improvement in the facial lines is shown in the face on the right in Fig. 17.

Class II, Division 1.

Let us take another case typical of another great Class—that of Division one of Class II. Cases belonging to this class are remarkably similar, as you know, scarcely differing except in the degree of protrusion of the incisors.

Fig. 16.

Fig. 15.

In this class the lower first molars occlude distally to the upper so that it is the disto-buccal cusp instead of the mesio-buccal cusp of the

Fig. 17

Fig. 18.

upper first molar that occludes in the buccal groove of the lower first molar, as in Fig. 20, thus throwing all of the lower teeth as they erupt in distal occlusion, and, of course, establishing a corresponding inharmony

in the facial lines of the patient, Fig. 21, which are augmented by other conditions not here necessary to consider. This condition creates the impression ofttimes that there is an overdevelopment of the upper jaw, and

Fig. 19.

naturally suggests the necessity of the sacrifice of the upper first premolars in order to reduce the upper arch to the supposed proper balance. But again I believe my theory holds good and that extraction can only

Fig. 20.

result in the patching up of one deformity by creating another, the result being far worse from an esthetic point of view, in most cases, than no treatment at all. Such a result is well shown in Fig. 22. It needs but a

very poor artist to realize how greatly out of harmony the upper lip is with the nose, and how unnatural and noticeable is the angle thus formed. Of course the result in this case is more noticeable on account of the shortness of the nose and undeveloped chin. But in any case of this class the result of extraction would be the same, varying only in degree.

Now what should have been done in this case, as in all similar cases, was to simply have placed all of the teeth in normal occlusion. We would then have brought forward the lower part of the face to be in better balance and proportion with the other features, as shown by a comparison of the next two pictures, Figs. 23 and 24.

Fig. 21.

Fig. 22.

Fig. 25 shows the facial lines in a typical case belonging to this class—that of a boy aged eleven years.

It will be seen, in Fig. 26, that the first molars have well-defined cusps which are locked in positions of distal occlusion. As time goes on the incisors in these cases, unless treated, become more and more prominent by reason of the lower lip tending to force them outward in the closing of the mouth. This is a striking characteristic of all cases belonging to this division of this great class. Fig. 27 shows the case after treatment. It will be seen that all of the teeth have been placed in normal

occlusion and the picture, Fig. 28, shows how well the balance of proportion has been established, and how well the law applies in this case.

Class II, Division 1, Subdivision.

In the subdivision of this division of this great class, or where only one of the lateral halves of the lower dental arch is in distal occlusion, the other side being in normal occlusion, the effect upon the facial lines, as in Fig. 29, is the same as in the full division just described, only less in degree, and we will find by comparing the contour of the face in Fig. 30 with that shown in Fig. 29, or after each tooth had been placed in its normal occlusal position, that the law applies equally well.

Fig. 23.

Fig. 24.

Class II, Division 2.

Cases belonging to this division of this class are characterized by distal occlusion of both lateral halves of the lower arch and retrusion of the incisors, as in Fig. 31, on account of normal breathing and normal

lip function, instead of protrusion of the incissors, as in Division 1, due to lack of proper lip function.

Thus it will be seen that the molar relations in the two divisions of this class are the same, but that the marring effect on the facial lines are vastly different, and yet that in each case, when the normal number of teeth are normally placed, as in Fig. 32, the lines of the face are brought to the best possible harmony—that the features balance, as may be seen by a comparison of the profiles of the face before and after treatment in Fig. 33.

Fig. 25.

Class II, Division 2, Subdivision.

Figs. 34 and 35 show the facial lines before and after treatment of a case belonging to the subdivision of division 2, Class II, or where only one of the lateral halves was in distal occlusion, the treatment in this as in the former cases being the establishment of normal occlusion. A study of the facial lines will show how perfectly the principle I am trying to impress you with applies, and as you study these pictures and note the changes following the application of this principle I would like to have you as students try to form in your minds the pictures that would have followed the time honored plan of treating these cases, where extraction—mutilation—is resorted to.

Class III.

Fig. 36 shows a typical case belonging to Class III, or where the teeth are in mesial occlusion—that of a girl aged thirteen years. The treatment consisted in placing all the teeth in normal occlusion, as shown in Fig. 37.

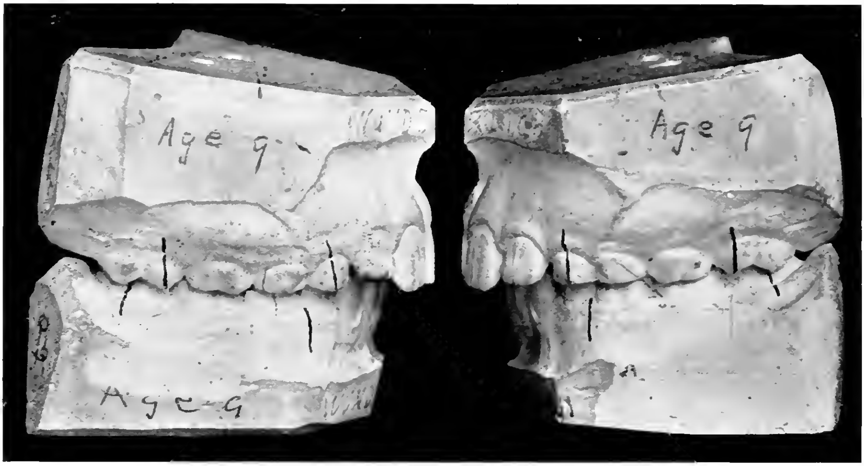


Fig. 26.

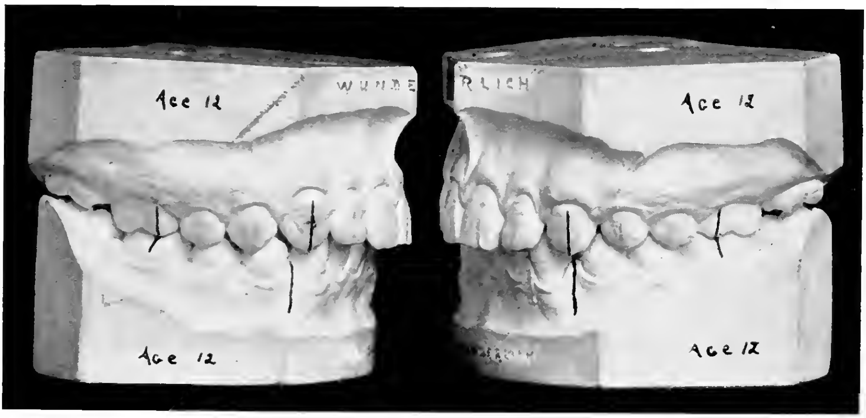


Fig. 27.

The improvement in the balance and proportion of the face is well shown in Fig. 38. Again the correctness of the law is verified.

The aggravated cases belonging to this class (cases belonging to which are always progressive) cannot in most instances be improved by

simple tooth movement, for they have passed beyond relief from orthodontia into the realm where surgery upon the bone itself is required. Hence the importance of beginning the treatment of these, and I may

Fig. 28.

Fig. 29.

Fig. 30.

add with all the earnestness of which I am capable, of *all cases,* early to obtain the best results both in art and in occlusion.

In conclusion let me repeat that my belief is that if we would con-

fer the greatest benefits upon our patients from an esthetic standpoint we must work hand in hand with nature and assist her to establish the relations of the teeth as the Creator intended they should be, and not resort to mutilation. And if I have not succeeded in converting you I hope

Fig. 31.

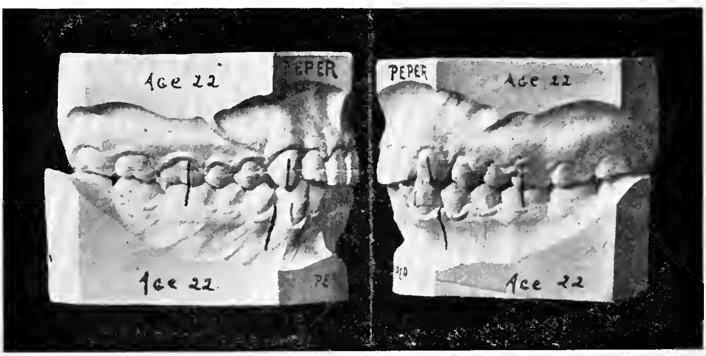


Fig. 32.

that I have at least set you to thinking most earnestly, and if so I know that it will result in at least a lessening in this horrible sacrifice of these priceless jewels—the teeth.

I thank you for your close attention and know of no more fitting way to close this lecture than to offer for your pleasure the inspection of the faces of the men who have been most earnest in the upbuilding of ortho-

dontia, and I would ask you to note, as I do with pride, what intelligent, well-proportioned faces are represented. I doubt whether a like number of the leaders in any other one great branch of dentistry would excel them in intelligence and artistic proportions.

Fig. 33.

Fig. 34.

Fig. 35.

Then were placed upon the screen in the following order fine likenesses of Fauchard, Fox, Harris, Tomes, Tucker, Westcott, Kingsley, J. W. White, Bonwill, Magill, Farrar, Guilford, Case, Baker, Brady, Matteson, Goddard.

Discussion.

Dr. Summa. I have had the privilege on previous occasions of listening to similar lectures by Dr. Angle. They afford me the same study and pleasure as a classic in music. It is impossible to hear a lecture of this kind often enough and a discussion of this discourse can be but by emphasis and affirmation. Who is there who can dispute the fact that occlusion is the basis of the science of orthodontia? Therefore it seems quite reasonable that retention and restoration of normal typical occlusion must bring about correct facial line. It is time that statements in regard to excessive number and size of teeth be limited to monstrosities.

Fig. 36.

Excepting these, nature makes no more a mistake in the number of teeth allotted to man than she does in the number of bones which form the framework of the human body.

It does seem pitiful that the dentist, the man who is supposed to devote his thoughts and employ his logic in unraveling the mysteries of tooth disease, should fall into the error of the superficially observing laity, in considering the apparent inharmony between the sizes of the fully formed crowns of the erupting teeth and the not yet fully grown bony and muscular structures of the human head, as a deformity. The evil consequences of extraction for this reason are appalling.

I desire also to voice my conviction that extraction of the first permanent molar for the prevention and correction of so-called irregularity of teeth is malpractice.

I do not deem it necessary at this time to rehearse any of the reasons for retaining the first permanent molars. But I do wish to state that the

most incriminating evidence against the advocates of this pernicious doctrine is offered by the illustration of cases which they imagine to have been benefited by the removal of the most important teeth of the human set.

Dr. V. E. Barnes. I want to tell Dr. Angle that I think he is wrong; decidedly so when he says that he is not an artist. Does the sculptor or the painter do as great a work as the man who changes and beautifies the living tissue? I cannot describe my feelings upon witnessing these pictures this afternoon. Perhaps you may imagine them for me when I tell you that my instruction in orthodontia came from a different school; one in which extraction is

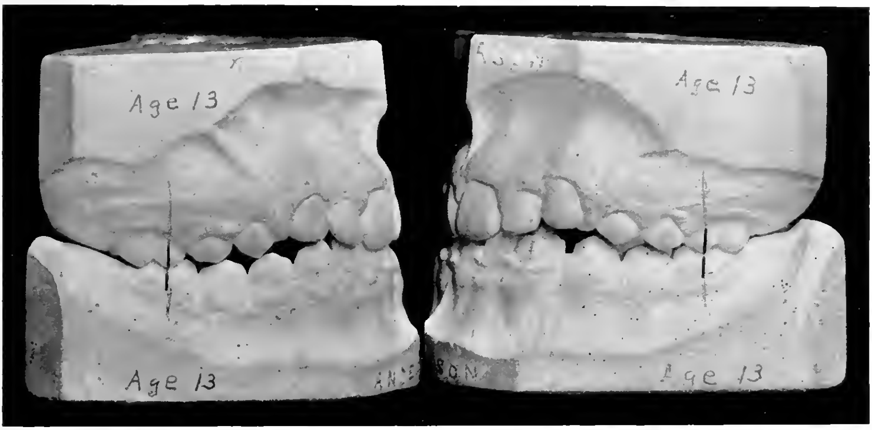


Fig. 37.

strongly advocated and in which occlusion is not considered as the basis of regulation. Long ago I doubted the wisdom of that kind of instruction and began to work and look for better methods and have been aided greatly by Dr. Angle's work. Teeth extracted for regulation will be a rarity in my office. The Doctor is right in what he says about the instruction in our dental colleges. Oh, that we could bring some concentrated action to bear upon the colleges and stop the foolish teaching that is going on. I have taught under a professor for three years, but I shall feel that I have accomplished something if I can undo some of that teaching. If I can get the dentists of my locality to stop extracting for regulating, it will go a long way towards correcting existing evils. Whether or not the maxillary bone grows after widening the arch is a question that will require a long time to settle definitely. It hardly seems creditable that

the vault can grow upward, but does not the alveolus grow downward? If we take two coincident arches and put one below the other the lower appears the larger, then if we move the lower up until they coincide, we see that there is no difference.

Dr. Angle. It is a larger circle.

Dr. Barnes. To me it seems that the growth must be in the alveolus.

Milton T. Watson. It seems almost needless to try to add anything to what has been said, yet an experience I have recently passed through has so impressed itself upon

Fig. 38.

my mind that I cannot resist mentioning it here. A year ago a patient was sent to me who originally had a very fine occlusion, except for a slight torso-occlusion of the lower lateral incisors. The family dentist believed that her lips and teeth were too prominent, so he proceeded to extract the four first bicuspids from this beautiful set of teeth, really among the finest I have ever seen. After working for a considerable time to close up the spaces the patient was referred to me. The situation was an awkward one, for I believed the loss of these teeth would seriously mar the facial lines, yet to fill in these four spaces with bridges was also very undesirable.

I considered the matter with the family dentist and finally decided to go ahead and close up the spaces as he had started to do, believing, under the circumstances, it would be better for everybody concerned. These spaces were closed up with comparative ease and, greatly to my surprise, did not disfigure the face as I had told the family dentist it would.

The patient went away for a vacation and upon her return a few days ago came in to see me, and really I could hardly believe my own eyes. Her facial lines had changed in the meantime to the extent of being seriously marred, yet the teeth were even more symmetrically arranged than at the beginning of retention. The change in the face was due largely to the shifting of the roots of the teeth. I grant you that in the beginning the teeth and lips were the least little bit too prominent for the rest of the face, but I believe if they had been left alone until the young lady was fully developed that she would have possessed a beautiful face, for she had one that was really very attractive to begin with.

I speak of this, if possible, to impress even more deeply upon your minds the truth of what Dr. Angle has shown regarding the extraction of teeth. I believe I have seen one or two cases where the extraction of a bicuspid above and below on one side, and the closure of this space by the retraction of the anterior teeth would bring about greater harmony of the facial lines, but I believe cases requiring such treatment to be extremely rare.

To the thoughtful, painstaking man the treatment of cases belonging to the second and third classes, by the use of "Baker Anchorage," is certainly infinitely more gratifying in the results, to say nothing of the greater ease, comfort, and speed with which it is accomplished over what was true when we were compelled to resort to extracting.

As to the head gear, I should dislike to feel I could not have it if I wanted it. While it is true that I have only had occasion to use it once in two years, yet if I had been deprived of it in this case I would have been most seriously handicapped. I quite agree with Dr. Angle, however, that the cases in which we have need of it are exceedingly few.

Dr. Angle. In closing I will try to be brief for I have already trespassed greatly upon your time.

First, let me thank you for your close attention to and appreciation of my talk. It encourages me to greater effort, but it will all amount to nothing unless it stimulates you to work and strive and think, think, think. Without this you will make no progress.

Oh, what a wonderful subject it is! So full of interest and fascination! Every face and every picture of a face you see is an opportunity for study, and oh, what vast varieties of faces! Such a mixing and blending of types! The pleasures of your travels everywhere may be

greatly enhanced by such study, as well as adding joy and value to your work. We must all be artists—not mere appliance-makers and adjusters, but real art must be behind and to a large extent direct our mechanics. And you cannot intelligently judge whether the principles I have enunciated today are correct, without being artists, therefore you cannot learn too much about art. You should study it in many ways and I would recommend that you read some or all of the following works on art: De Forest's "Short History of Art;" Mrs. Van Rennselaer's "Six Portraits;" Sensier's "Millet;" Sensier's "Rembrandt;" Reynold's "Talks to Art Students," and Hunt's "Talks on Art."

And now it is incumbent upon me not only to close this discussion, but to end my duties as your presiding officer for this year. Twice you have honored me by making me your President, and I shall always be very proud of the fact, for I believe this is one of the most truly earnest and honest societies in the world. I have in my feeble way done my best, but my efforts would have amounted to but little had I not had encouragement and strong assistance from you all, and now it comes time for me to lay down the gavel. I feel proud to turn it over to so worthy a successor as Dr. Watson. I know that he will be earnest and diligent, and I believe that the same earnestness and diligence will also be manifested by all the committees and members. I thank you one and all.

Some Observations on Mouth Breathing.

By William J. Brady, D.D.S., Iowa City, Ia.

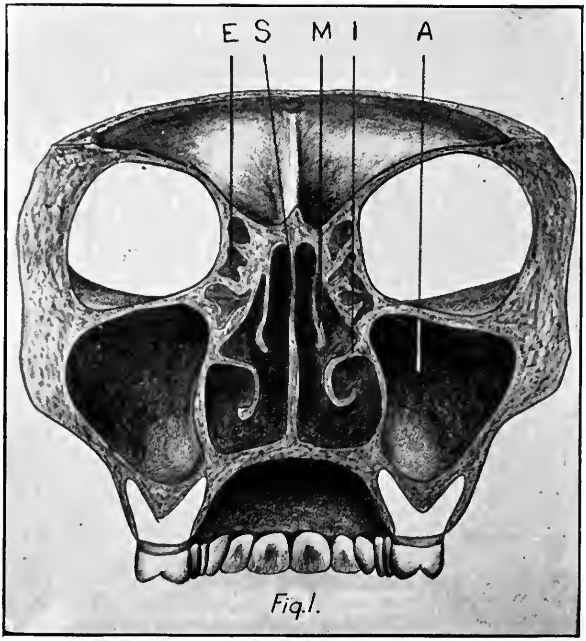
(Illustrations from original charts prepared by the author.)

Mr. President and Members of the Association: Some two or three years ago my attention was seriously directed to the subject of mouth breathing. I had noticed it in a superficial way for years, but its full meaning did not appear to me till some time ago. The first thing that struck my attention was the prevalence of this trouble; the second was the ignorance and indifference with which this condition was viewed; and last, the far reaching and injurious effects of mouth breathing impressed me.

But little has been written or said that has been heeded about mouth breathing, though more than half the children of the country are afflicted with some of the troubles that cause it; physicians are seemingly careless or indifferent concerning it and its effects; parents are absolutely ignorant of its meaning to their children, and dentists, I am sorry to say, are as ignorant as parents. All this is lamentable, because mouth breathing is largely a trouble of childhood, when the health of the oncoming race should be fostered and protected by those older and wiser, who know (or should know) that health is the greatest blessing that can be given to posterity.

It is popularly supposed by many, by the profession as well as the laity, that mouth breathing is a habit, something to be done or not just as the child pleases, just as making faces or raising a fuss when put to bed is a thing to be done at will. Mouth breathing is nothing of the kind; it

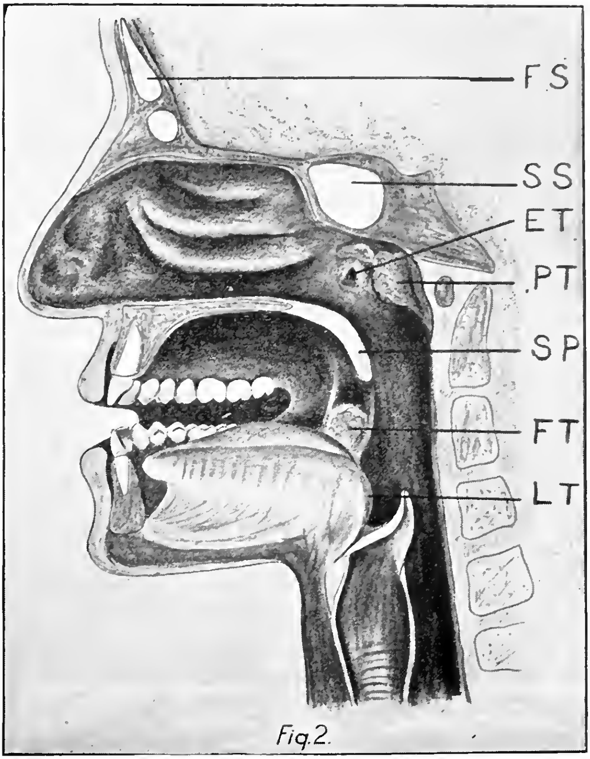
is an expression of an abnormal condition, and sometimes of deep seated disease. The abnormal conditions which cause mouth breathing are seldom painful, and largely for this reason are they overlooked. The child knows nothing of their presence, and because the child does not complain, the parent makes no inquiries or examinations.



Cross section adult skull.
E, ethmoid cells; S, septum; M, middle turbinate; I, inferior turbinate; A, antrum.

Though mouth breathing is a trouble of childhood, its effects are to a greater or lesser extent permanent through life, as it affects the proper development of the child in many ways, many of which conditions remain fixed after the period of growth is past. For instance, those who are habitual mouth breathers from childhood to youth are flat chested and have insufficient lung capacity, which condition persists through life. Mouth breathing affects the development of the entire nasal tract, the bones of the face, the nose itself; it affects speech and hearing, and what all dentists should know, it affects the shape of the dental arch, and usually the position of the lower jaw as well, causing great inharmony of the facial lines. It is even believed that it affects the intelligence of growing children, as many times children thus afflicted appear dull and listless in

school; but it is also found that in such cases the hearing is considerably affected, and the child being thus deprived of this sense lacks the knack of picking up things as quickly as the others, which may partially account for the seeming dullness. Mouth breathing certainly has an effect upon



Vertical section of mouth and nasal passages.
FS, frontal sinus; SS, sphenoidal sinus; ET, eustachian tube; PT, pharyngeal tonsil; SP, soft palate; FT, faucial tonsil; LT, lingual tonsil.

the general education and the general health, as well as creating a predisposition to nasal, aural, bronchial and lung troubles.

Anatomy of Nasal Tract.

Before beginning any further consideration of the subject, the anatomy of the nasal tract should be briefly rehearsed, and its chief physiological functions mentioned. The accompanying charts are not offered as absolutely correct anatomically, but only as diagrammatic in character, although they are made from careful anatomical study, and are not seriously incorrect.

Fig. 1 is a cross section of part of an adult skull, the separation being

between the first and the second molar teeth, the section cut off being viewed from behind. The nasal opening is bounded by a floor (which is the ceiling of the dentist's apartment) by two walls, and a roof, and is divided in two by the nasal septum. The nasal tract is traversed lengthwise by the turbinated bones, which partially divide the opening into different chambers, known as the superior, middle, and inferior meatus, respectively. Of these, the inferior meatus or channel is much the largest, and through this most of the air passes in normal breathing. The outer walls of the nasal opening form the inner walls of the antra, which open into the nasal tract (not shown in the chart). The ethmoid cells (imperfectly shown in the chart) also connect with the nasal opening. The frontal and sphenoidal sinuses, shown in Fig. 2, also connect with it, where is also seen the opening of the Eustachian tube, through which the middle ear is connected, this in turn communicating with the mastoid cells of the temporal bone. It is thus seen how diseases of the nasal tract may involve other tissues seemingly remote.

Fig. 2 shows the division of naso-pharynx and oro-pharynx, the soft palate being the dividing line. The naso-pharynx is subdivided into anterior, middle, and posterior nares, the last being that part between the posterior portion of the turbinated and the end of the soft palate. The tonsils are here shown, and are of particular interest in this connection, as hypertrophy of the tonsil (particularly of the pharyngeal) is the most prolific cause of mouth breathing. The tonsils are ordinarily supposed to be two in number, whereas there are four, and sometimes six. These are: the faucial tonsils—the ones ordinarily seen—located on either side of the opening to the pharynx; the lingual tonsil, located at the base of the tongue; and most important to us, the pharyngeal tonsil, located on the posterior wall of the pharynx, behind and just above the soft palate. This tonsil is also called Luschka's tonsil, Luschka's gland, the third tonsil, etc., and is entirely out of sight by ordinary observation. It extends on either side to near the opening of the Eustachian tube, and a small extension of the tonsil sometimes nearly surrounds this opening, which extension is called the tubal tonsil.

The pharyngeal tonsil, while a distinct histological structure, is a tissue of childhood and early youth; it normally atrophies and disappears by about the fifteenth to sixteenth year, unless it becomes diseased, when parts of it may persist much longer. The physiological reason for this structure and its disappearance is not explained.

The mucous membrane lining the nasal tract is also of interest in connection with our subject. This membrane varies widely in character in the different localities to which it extends. In the various sinuses which

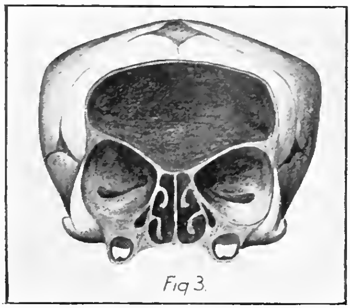
it lines, it consists of a very thin layer, and is not underlaid with any appreciable submucous tissue. Over the turbinated bones, the submucous layer is quite thick, and is richly supplied with blood vessels, which vessels become engorged during inflammatory conditions, adding appreciably to the thickness of the membrane, and as the bony walls are unyielding, the thickened membrane fills up the space and restricts the passage of air. This is experienced in an ordinary cold, when normal breathing becomes difficult on account of this thickening. There are various glandular elements in the membrane and submucous tissues, which are most numerous in the nasal tract proper, and which add to the stoppage of the tract when diseased.

The physiological function of the nasal tract in normal breathing is of more importance than it would seem at first thought. We find first, that by passing through the nasal passages the temperature of the inspired air is raised to nearly blood heat before it enters the delicate tissues of the bronchii and lungs; second, that an appreciable quantity of moisture is added from contact with the mucous surfaces; and third, considerable quantities of dust and bacteria are separated by entanglement with the nasal mucus. Most of these features are lacking when the air is drawn into the lungs through the mouth instead of through the nose as Nature intended, and this changed condition has a direct effect upon the development of the lungs and chest. The continued inspiration of unwarmed and unmoistened air most unfavorably affects the delicate tissues of the lungs, and the tendency is to breathe much less air than normal. Instinctively the tissues shrink from contact with unprepared air, and it is well established that lack of full breathing means lack of development of the lungs and chest. Children in whom mouth breathing is firmly established are invariably flat chested, and of insufficient lung capacity; and when the growing period has once passed, no amount of gymnasium work or other practice will more than partially restore it, and the condition remains permanent through life. The general health is affected in a way from this lack of breathing fully, as there is lack of oxygenation of all the tissues of the body; and the pathological conditions that arise or are favored by imperfect oxygenation would form a chapter in themselves.

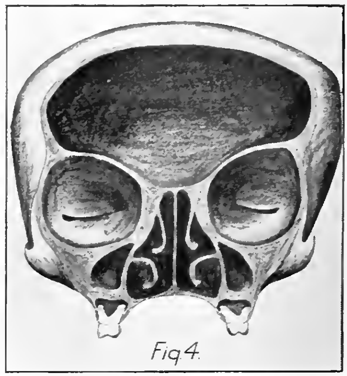
Besides affecting development in general as noted, mouth breathing most seriously affects the development of the nasal tract itself, and all its associated parts. From failure of passage of air through it, the tissues of the nasal tract are not required to perform their natural functions, and the normal stimulus to growth and development is lacking. The function of warming and moistening the inspired air naturally requires a vigorous and healthful circulation of the blood, the nervous elements are kept act-

ing and reacting, the required stimulus toward growth is supplied, and the healthful and normal development of all the tissues, including the bones of the face and their contained sinuses, is a matter of course. It must be remembered that all the bones of the face are closely connected, and that growth of one part stimulates development of all the others.

We will now briefly consider the normal development of the nasal tract and its associated parts. Fig. 3 shows a cross section through the face at birth, just in front of the temporary second molar. It is seen that the nasal opening is not large; the walls are extremely thin, little more



Cross section, at birth.

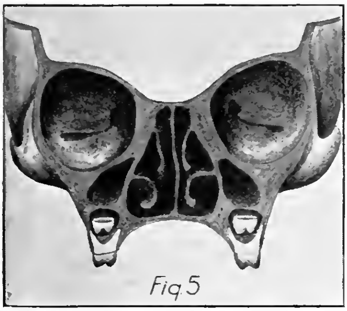


Normal development, three years.

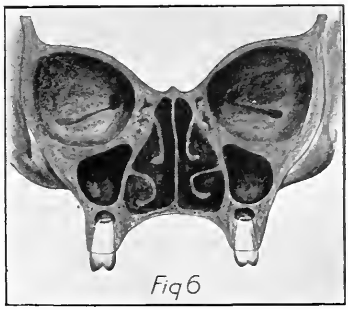
than membranous—especially true of the septum. There is a very small antrum, large enough to contain a medium sized shot. The roof of the mouth is quite flat; no teeth being erupted, there is no alveolar process; in fact only parts of the teeth are yet calcified, and every part is necessarily very immature. There is no glenoid cavity whatever, nor trace of eminentia articularis. The auditory canal opens to the external surface, and in a skull of this age the bones of the ear are exposed in the opening. As a matter of interest it may be added that the sense of hearing is almost entirely wanting at birth.

Fig. 4 shows the development attained at three years. The nasal opening has increased in comparison to the size of the skull, and the antra are larger, though still small. The roof of the mouth is more dome shaped, due to development of both maxillary bone and alveolar process; the alveolar process to hold the teeth now erupted, and the maxillary bone to contain the developing germs of the permanent teeth. The auditory canal is somewhat developed, but still very short. As yet there is no glenoid cavity, nor eminentia articularis.

Fig. 5 represents the development at eight years. The nasal opening has increased considerably in size, but the antra are but little larger than at three years. This is due to the fact that the maxillary bones are almost entirely occupied by the crowns of the permanent teeth. The maxillæ have undergone considerable development to contain all these teeth, and the alveolar process surrounding the temporary teeth has increased in proportion as these teeth have attained full development and have been put to hard use. The dome of the mouth has apparently increased in height, but in reality the sides of the dome have extended downwards, thus increasing its size. At this age a slight deviation of the septum usually occurs, ordinarily to the left side. The glenoid cavity begins to be defined, but as yet is very shallow, and allows the greatest freedom of motion. The eminentia articularis begins to appear as a slight ridge.



Normal development, eight years.



Normal development, thirteen years.

Fig. 6 shows the state of development at thirteen years. The nasal opening has enlarged some over the last figure, and the antrum has enlarged decidedly. This is because the permanent teeth have now erupted, giving Nature a chance to absorb the interior of the maxillæ, which bones have also enlarged with the general growth. The alveolar process has increased to accommodate the permanent teeth, and the dome of the mouth is wider laterally. The growth of both maxillary bones and alveolar process is downward, and while the dome seems to rise in height, yet it does not, or it would decrease the opening of the nasal tract, which we see does not occur. The glenoid cavity is fairly well defined, though not nearly so deep as in the adult. There is great freedom of movement of the condyle, a fact which accounts for the ease with which a malposition of the lower jaw is attained during childhood.

Fig. 1 shows the development in the adult. Here we see the final enlargement of the nasal opening, with the full development of the antrum.

The antral development is greater in the male than in the female, and continues longer before it reaches completion. The dome of the mouth has reached full size, as the permanent teeth have elongated fully as to roots. The development depends largely upon the use the teeth receive, being greatest where the teeth are most used, and being more or less deficient where for any reason there is lack of full use of these organs. A fully developed dome does not occur in cases of any considerable malocclusion, where by the nature of things the teeth cannot receive full use.

Causes and Effects of Mouth Breathing.

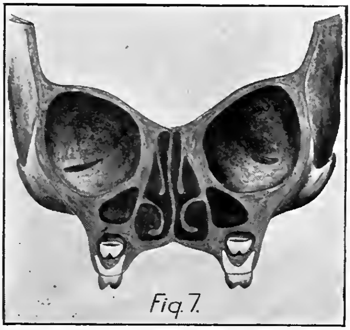
Having considered normal development, we are ready to study the effects of mouth breathing. Immediately the question arises as to what causes mouth breathing. There are many inflammatory conditions known to the rhinologist which tend to enlarge the soft tissues of the nasal tract, reducing the size of the air passages very materially, and in some conditions closing them almost entirely, compelling breathing through the mouth to get the necessary oxygen to sustain life. It is not the province of this article to deal with these diseases specifically, but a few of the most important will be mentioned. First are the different varieties of chronic hypertrophic rhinitis—called catarrh by the laity—in which the tissues are so engorged with blood and otherwise thickened that the air passages are very much reduced. Next is atrophic rhinitis with polypi, which growths sometimes completely stop the nasal opening. But most common of all is hypertrophy of the pharyngeal tonsil, usually called adenoid vegetation, or simply, adenoids. Adenoids are distinctively a trouble of childhood, and afflict probably half the children of the country, usually without attracting attention, because of their painlessness. They usually become established at from six to ten years, and are the most prolific cause of mouth breathing.

It is sometimes gravely asserted that mouth breathing is caused by the shape of the dental arch and the high vault of the mouth, but these things are products of mouth breathing, not causes, as we shall see. There are many other contributory conditions toward establishing mouth breathing, but all operate in the same way, namely, by helping to close the air passages. Without further discussion it may be said that it is settled that mouth breathing occurs just in proportion as normal breathing becomes difficult, and this unconsciously on the part of the subject. The demand for oxygen is ceaseless, and is immediate. If it is not readily supplied through the nose, the mouth opens at once to admit the life-sustaining element. The subject has no time to meditate on the harmful effects of breathing unwarmed air; oxygen he must have, and at once, and he gets it in the easiest way he can.

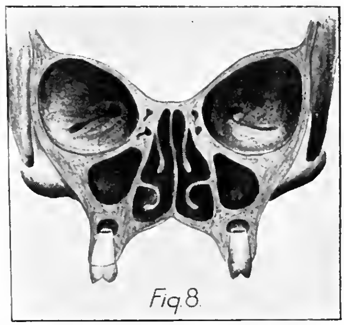
Fig. 7 shows a section through the face of a young mouth breather

(aged eight), where the condition has been established some little time, as it may easily be at this age. Already the nasal opening is reduced slightly; the antrum is less developed than normal, as also the maxillæ, which in turn gives less room for developing teeth. There is narrowing of the dental arch due to lack of development, for the temporary arch normally widens bodily in a lateral direction as the maxillæ develop, a fact not generally recognized. This makes the dome appear slightly higher than usual, though possibly it is not. However, the walls and septum of the nose develop from above downward, and it seems reasonable to believe that lack of development on their part may tend to a slight raising of the roof of the mouth.

The same thing is seen in Fig. 8, which represents the same case at thirteen years. Here the roof of the mouth seems higher than normal, and we all know the face is much narrower than normal in such a case. The



Mouth breather, eight years.

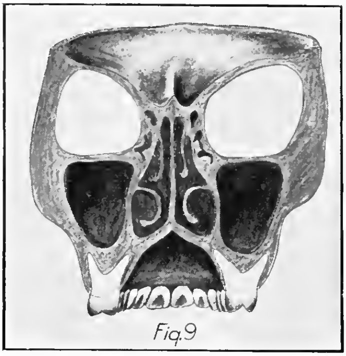


Mouth breather, thirteen years.

nasal opening is much compressed, the maxillæ small, and of course the antrum. While this drawing is not from an actual specimen, it is not overdrawn as to the actual conditions present in a majority of such cases.

Up to this age, development has merely been held back by mouth breathing. If the cause is removed and normal breathing made possible, Nature will soon make amends, and at least partially develop the stunted parts; and if helped by the orthodontist, will fully develop them in most cases. Spreading the arch acts as a stimulant which meets with a quick and ready response in increased growth and development of all the bones and tissues of the face. The results in this line are something wonderful indeed under skilful and intelligent treatment. But if not done by this age—or very soon after—the matter is decidedly different; development of the entire bony framework of the face gradually comes to a stop, and

by twenty-two years we have the condition shown in Fig. 9, which then is practically permanent through life. Here is a small and narrow nasal opening, with turbinates encroaching, awaiting the rhinologist's removal in the effort to enlarge the air passages. The maxillæ are under developed, also their contained antra, and though the adenoids may have almost entirely disappeared by this time, or the catarrh have been cured, yet the effects of all these years lack of normal breathing still remain. The voice is thin, with a decided nasal twang; the dental arch is narrow, with a vault usually—though not always—higher than normal. No treatment at this age on the part of the orthodontist is likely to aid materially in enlargement of the bones of the face (and with them the nasal passages), for the



Mouth breather, adult.

period of growth is past, and the stimulus given by spreading the arch meets with no response in quickened growth, as when done earlier. The case is doomed to practically this condition during the rest of life.

Effects of Mouth Breathing on the Dental Arch.

In addition to the abnormal development of the bones of the face shown, the shape of the dental arch is affected by continued mouth breathing. This has been recognized in a way heretofore, but I believe the full effects have never been fully shown. The "mouth breathers arch" has often been mentioned, though just what is meant by this term has never been clearly described—at least not to my knowledge—and while considerable rambling discussion has occurred over the origin and meaning of the malformations found in connection with mouth breathing, nothing definite or dependable has yet been given.

There are two distinct forms of dental arch that result from continued mouth breathing during the period of development; each is distinct from the other, and both are distinct from a normal arch. These arches are found only in cases of mouth breathers, and are always found in greater

or lesser degree in such cases. This latter point is disputed by certain rhinologists, who claim that a normal arch is sometimes found in mouth breathers; but in all cases of this kind that I have seen, I have found that the first indications of a mouth breather's arch were forming, and that the eye of the rhinologist, inexperienced in dental matters, had failed to distinguish it from a normal arch.

These two forms of mouth breather's arch I shall call the U-shape* and V-shape varieties, for want of better names. Before describing them and their evolution in detail, it should be recalled that all irregularities of the teeth are progressive, and that these arches gradually assume these forms, the same as the bones of the face gradually develop abnormally. It should also be stated that there is a difference in degree in these cases, some showing the characteristics faintly and others showing them strongly,

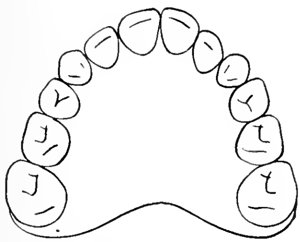


Fig. 10.

U-shaped arch, eight years.

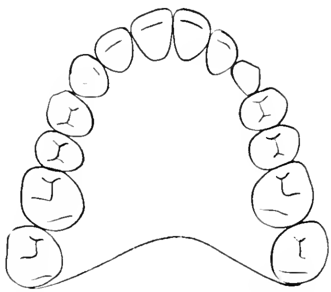


Fig. 11.

U-shaped arch, thirteen years.

but that they may always be discovered in some degree in all cases where chronic mouth breathing occurs during the years of growth and development. The illustrations given show average cases, neither the least affected nor the very worst.

The U-shaped arch somewhat resembles the letter U, as its name would indicate. In its earlier stages it is but little differentiated from a normal arch, though in its later forms it is easily recognized. Fig. 10 shows this form of arch at eight years, when the first molars and the four incisors are the only permanent teeth yet erupted. Here it will be noticed that the incisors are protruded forward, merely enough that it can be noticed. We have already seen (Fig. 7) that the maxillæ do not develop laterally the normal extent, and there is a consequent slight narrowness of the arch in the region of the molars. This narrowness and the protrusion of the incisors is often small in extent, and is easily passed over as

*Name suggested by Dr. W. M. Hyatt.

normal. But as the case progresses it becomes more noticeable, and is easily distinguished in Fig. 11, which shows the case at thirteen years. Here all the temporary teeth but one cuspid have been lost, and the second molars have been added to the arch. The narrowness through the region of the bicuspids and first molars is quite apparent, and attention is again called to the lack of lateral growth of the maxillæ shown in Fig. 8.

Fig. 12 shows the full development of the U-shaped arch, after the third molars are added, the case shown not being an extreme one. It is seen that the greatest narrowness is in the bicuspid and first molar region, the second molars being less affected, and the third molars still less. The incisors are protruded somewhat, or correctly speaking, are placed labially to the line of normal occlusion. In some cases the incisors are protruded

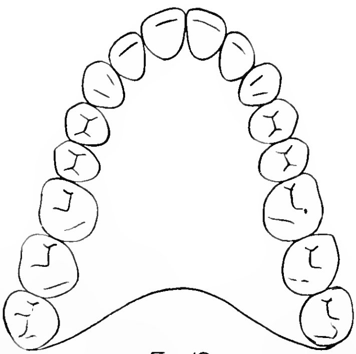


Fig. 12.

U-shaped arch, adult.

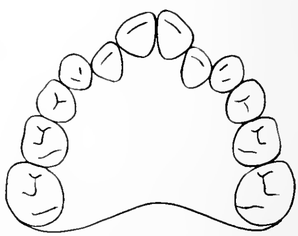


Fig. 13.

V-shaped arch, eight years.

much more than represented; in some there is space between the teeth, varying from a little between the centrals and laterals up to fully an eighth of an inch between each tooth back even to the second bicuspids.

In all cases of the U-shaped arch, from the earliest beginnings to the fully established forms, the following characteristics may be seen in some degree; the arch is round in front—U-shaped—there is usually slight protrusion of the incisors; there may or may not be space between the teeth; the teeth are seldom in torso-occlusion, and very slightly in any case; the laterals are as prominent relatively as the other teeth; the cuspids are not more prominent than the rest, and almost always erupt fully; the arch is narrow in the bicuspid and first molar region, being less affected in the region of the second molar, and still less in that of the third molar.

The V-shaped arch differs from the U-shaped in many details, though in a general way there is a similar protrusion of the incisors and the same narrowness in the bicuspid and molar region. As the name indicates, the arch resembles an inverted V, and it is easier to distinguish from the normal than the U-shaped arch, especially in the earlier stages. Figs. 13, 14 and 15 represent the development of the V-shaped arch at the ages of eight, thirteen and twenty-two years, respectively. The chief characteristics are: the arch is never round in front, but is always more or less V-shaped, the apex of the V resting at the mesio-occlusal angle of the centrals; the incisors appear to protrude more or less, though this is usually more apparent than real; there is seldom if ever space between the teeth; the centrals are usually both in torso-occlusion, though sometimes but one may be, and occasionally neither one is appreciably so; the laterals are always crowded within the line of normal occlusion, and almost invariably in torso-occlusion, usually considerably so; the cuspids (permanent) nearly always appear prominent, and many times are not fully erupted;

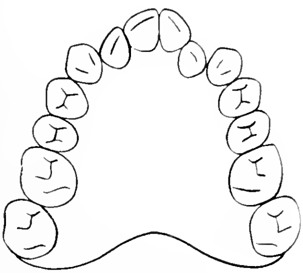


Fig 14

V-shaped arch, thirteen years.

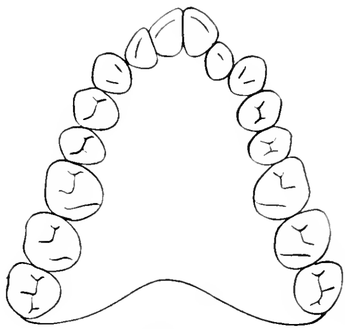


Fig.15

V-shaped arch, adult.

the arch is narrow in the bicuspid and molar regions, almost exactly like the U-shaped arch.

These two forms of dental arch are distinct from each other at all times; that is, the characteristics of one never mix nor combine with the characteristics of the other, and neither form ever merges or changes to the other at any period of development; each is distinct from the beginning. Both forms are unmistakably connected with mouth breathing, and as before stated, are found nowhere else, and further, are always to be found in some degree connected therewith. The statements of rhinologists that these forms are not always present are undoubtedly founded on inac-

curate observation, which is not at all strange, for the rhinologist sees the teeth only with a layman's eyes, and only as an incidental matter even then. The trained eye of the orthodontist will have no trouble in distinguishing the characteristics of these arches in all cases. The two forms of arch are about equally divided in point of numbers, there seeming to be as many of one as the other.

The meaning of this difference in form of the mouth breather's arch is a mystery to me. As yet I have no explanation to offer, unless it might be that biting the lower lip, as pointed out by Dr. Angle, might have some influence in producing the U-shaped form, and failure to assume this habit might result in the other. This hardly appears a probable solution when it is remembered that lip biting is a secondary incident, and occurs because the lip falls in between the teeth, and the habit is assumed largely on account of the tendency of the muscles to be doing something. Lip biting, therefore, usually does not begin till the case is somewhat established, whereas the particular form of arch is established from the beginning. Outside of this conjecture, however, I have nothing to offer in the way of explanation. Here is certainly a field for further investigation.

It will be noticed that the upper arch only has been mentioned and illustrated so far; the lower now demands our attention. Strange as it may seem, the lower arch is comparatively little affected in mouth breathing. With the U-shaped upper, the lower is usually quite regular in form, excepting a very slight narrowness in the bicuspid region not nearly so great as the narrowness of the upper. The incisors and cuspids are usually quite regular, although somewhat elongated beyond the normal, especially in the later stages of the case. With the V-shaped upper, the lower incisors and cuspids are usually somewhat overlapped, and are elongated beyond the normal as before. The arch is slightly narrower in the bicuspid and first molar region in comparison to the U-shaped lower, but still not so narrow as the upper in the same regions.

Cause of Narrowing of Upper Arch.

The fact of the excessive narrowness of the upper arch in mouth breathing naturally leads to the question of its cause. Many replies to the question have been given, no one of which seems to answer it fully. One of the most common ideas entertained is that pressure inward by the cheeks when the mouth is opened for breathing produces the narrow arch and high vault of the mouth breather. That considerable pressure inward is possible can easily be demonstrated by placing the finger between the cheeks and gums, high up alongside the bicuspids and molars, and then opening the mouth; pressure inward is easily felt. It would seem that this inward pressure would affect the lowers the same as the uppers, whereas the lower arch is but little affected:

The same experiment shows considerably less inward pressure on the lower teeth than on the upper.

But before accepting this explanation as correct, it should be remembered that there are other contributary causes to the condition, and that probably no one cause is responsible for the condition, but a combination of several; and it is not settled that the real cause or causes have yet been discovered. It is certain that the teeth are very easily moved at the time of their eruption, and that considerable pressure is exerted inward by the cheeks of the mouth breather, seemingly more upon the upper than on the lower; and it is also certain that mouth breathing through the hours of sleep would amount to about eight hours out of the twenty-four, or practically one-third the time; yet we are not certain that this is the chief cause of the malformations of the mouth breather. While inward pressure of the cheeks might easily influence the position of the teeth and accompanying alveolar process, this force certainly does not seem great enough to influence the shape of any other bony structure, nor cause the high vault of the mouth breather, if the vault really is higher than normal.

The protrusion of the incisors is favored by the peculiar changes in the lip as mouth breathing advances. From lack of performance of function the nose is more or less non-developed; the nostrils are contracted, and the tip of the nose drawn upward. This contraction extends to and influences the upper lip, which is also gradually drawn upward, covering the teeth less and less, thus slowly losing its own function. As it performs its duties with decreasing regularity, it changes its form from a thin flat band to a round thickened roll of muscle, and thus adds to its own inability to cover the teeth properly. It will be recalled that the incisors of the mouth breather usually appear quite protruding and prominent. This is often more apparent than real, on account of the short and thick lip failing to cover them. The restraining influence of the lip removed, however, the incisors sometimes stray widely from their normal positions, and the protrusion is quite considerable in many cases.

There is another feature that adds to the protrusion of the teeth, the habit of biting the lower lip, as pointed out by Dr. Angle. As before noted, I believe this habit to be a secondary affair, and that it does not occur till the mouth breathing has become somewhat established, when the lower lip falls readily beneath the upper teeth, and the habit of lip-biting occurs unconsciously as a result of the nervous unrest always present when the occlusion does not give a resting place to the lower jaw. It is a settled fact that wherever the lower jaw does not find a regular and comfortable resting place by reason of a fixed occlusion, the muscular action becomes uncertain and variable, and sometimes uncontrollable except by considerable effort on the part of the patient. The lack of complete mus-

cular rest leads to a condition of unusual nervous irritability and activity, and in turn this produces muscular action of all the parts affected, varying in degree from a mere uneasy movement of the lips or jaws up to continued grinding of the teeth accompanied with muscular twitchings or other unusual and abnormal movements. In case of a mouth breather, the upper arch gradually narrows while the lower expands to almost full width, thus giving a constantly changing occlusion—or rather mal-occlusion—thus giving a basis for the nervous disturbance noted, and leading to lip-biting as one of its manifestations. When the habit is once established, however, it aids materially in increasing the unsightly prominence of the upper teeth.

Cause of High Vault

It has now been seen that the narrowness of the upper arch and the protrusion of the anterior teeth may be reasonably accounted for by reason of inward pressure of the cheeks and failure of restraint of the upper lip, added to in some cases by biting the lower lip, but the narrowness of the nasal tract and seeming height of the vault are not thus reasonably explained. It would seem that the mouth breather's malformations must be the result of several minor causes, coupled with failure of development arising from lack of proper nervous stimulation. To reach the ultimate cause or causes of mouth breathing would involve many questions of both physiology and pathology, as well as deep study of the laws and effects of heredity and degeneracy, which is altogether beyond the scope of this effort. Without attempting to reach the ultimate cause, it is sufficient for all practical purposes to the orthodontist to know the immediate and exciting causes of the mouth breather's troubles.

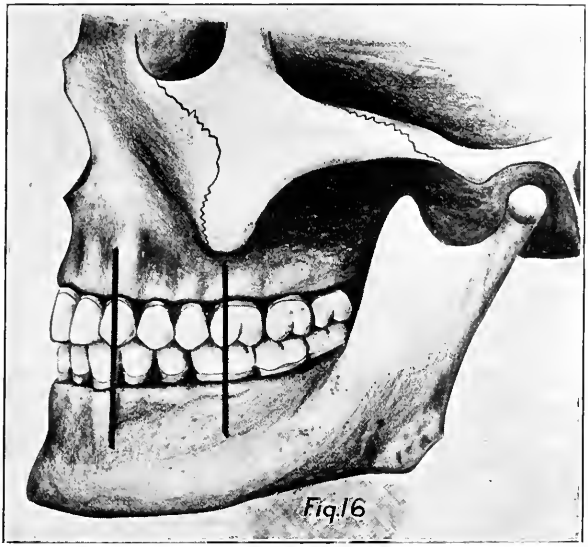
While passing, it may be of interest to state another explanation sometimes given as to the mouth breather's high and narrow vault, which is that when the nasal tract is stopped up the pressure of the atmosphere "caves in" the tract; but this cannot be, for even if the opening is stopped up completely posteriorly, it is still open anteriorly, and a "cave in" could not occur without a vacuum. The explanation of "negative pressure" being the cause is clearly untenable.

The question still remains whether or not the roof of the mouth is higher than usual in the mouth breather. In some cases it undoubtedly is so; in others it seems very high till the arch is expanded, when it appears of the usual height; and in others it seems no higher than usual at any time. The question is interesting, especially in the cases where the vault seems of the ordinary height after expansion; but there arises the new question of whether or not the roof of the mouth was pulled down in expansion. We must leave this as one of the unsettled points, though the

supposition is that the mouth breather's arch averages somewhat higher than normal.

Retrusion of Mandible.

There is still another feature that invites our attention, though it is a secondary result of the narrowing of the upper arch, and is not exclusively connected with mouth breathing, being found in many other cases where a similar narrowing of the arch produces malocclusion. I refer to the retrusion of the lower jaw almost always found accompanying the mouth breather's arch. This retrusion may be explained as follows: The upper arch becoming more contracted than the lower one, the cusps of the lower teeth cannot interdigitate between cusps of the uppers



Normal occlusion, side view.

as usual, and the lower jaw cannot find a resting place in the normal position; and in the search for such resting place it finds relief slightly posterior to normal, where also the inclined planes of the various cusps would tend to force it from the narrowing of the upper. As the upper continues to keep narrow while the lower widens, the lower gradually moves backward more and more, till it finally retrudes the width of an entire bicuspid. As a reminder of what constitutes normal occlusion, and as a guide in determining malocclusion, Fig. 16 is given. This shows a side view of a normal occlusion, where the lines crossing the molars and cuspids indicate that each cusp is in its appropriate place, and likewise the entire lower jaw is in its proper position, and in harmonious relation to the upper. The

mesio-buccal cusp of the upper first molar occludes in the buccal groove of the lower first molar, and the upper cuspid occludes posterior to the lower cuspid. These are the most prominent landmarks, but the occlusion of any of the other teeth may be taken as a guide also. Fig. 17 shows a contracted upper and a practically normal lower, with a line (A) drawn from cusp to cusp of the lower first bicuspids. These cusps normally should occlude in the embrasure between the upper cuspids and the first bicuspids on each side, but the line B (exactly the same length as line A) shows that the lower cusps would occlude somewhere labially to a proper position, giving anything but a satisfactory closure of the jaws. But by re-

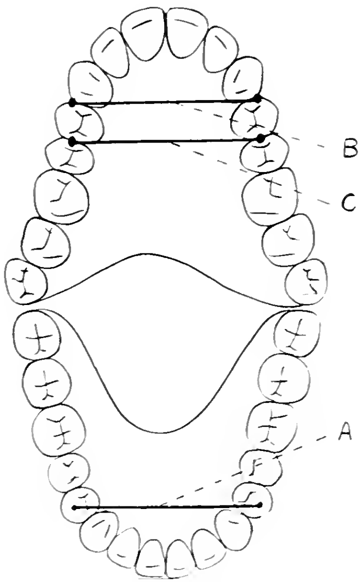


Fig. 17.

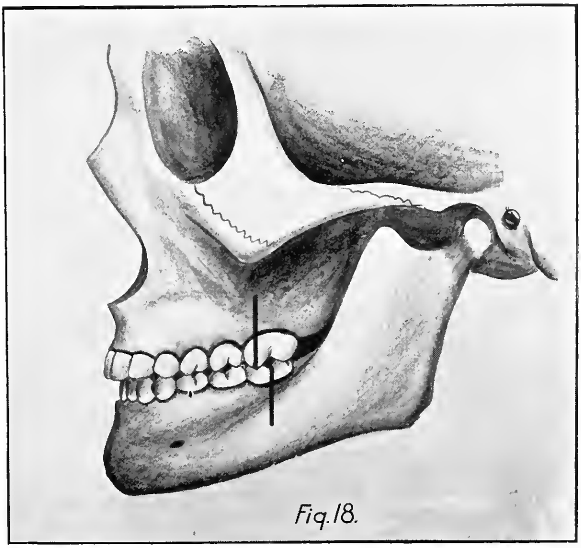
Development of retrusion.

trusion of the jaw till the same lower cusps would occlude in the embrasure between the upper bicuspids, as shown by line C, a fairly comfortable occlusion would be obtained, as these teeth are the right distance from side to side to accommodate the lowers. Every other cusp on the lower teeth would be accommodated one notch back of the normal in like manner.

It must be remembered that the lower jaw is a very movable fixture, and is simply slung against the upper by the muscles, much as the springs of a prepared skull hold the lower jaw up against the upper. It has also been seen that the glenoid cavity is very shallow during the period of growth, allowing great freedom of movement of the condyle. The idea

that the lower jaw is fixed in its position upon the eruption of the first molars, and does not change after that, is a mistaken one; though the proper interdigitation of the cusps of these teeth is a powerful factor in holding the jaw in its proper position, yet there are often forces sufficiently powerful to overcome their restraining action, and the jaw is either retruded or protruded, according as the mechanics of the occlusion favors. A malocclusion of these teeth is as powerful a factor in producing a change in position of the jaw as a normal occlusion is in maintaining a correct position.

Retrusion is the almost invariable accompaniment of mouth breathing, though in perhaps two per cent of the cases the lower jaw is not forced

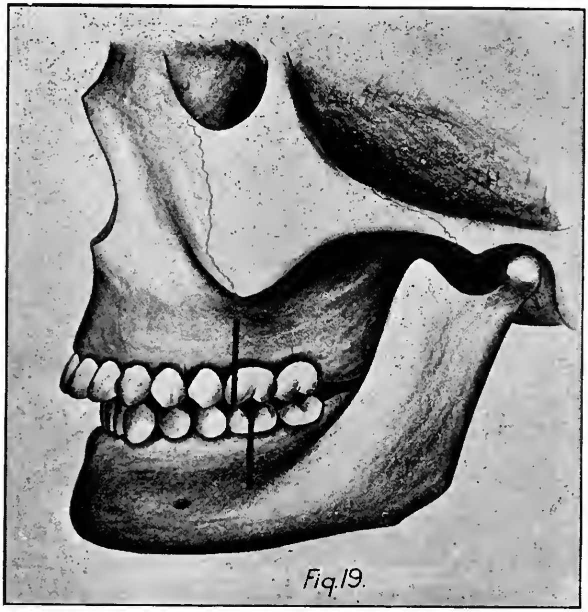


Beginning retrusion, eight years.

back far enough to make any practical difference. This retrusion may be on both sides or only on one side, and may vary from the width of a bicuspid on each side to just enough to be noticeable on one side only. So far I have never seen a case of protrusion of the lower jaw due to mouth breathing, as the mechanics of the case always favors retrusion rather than protrusion.

Of course the retrusion mentioned does not occur all at once, the same as the form of the dental arch or the bony development does not arrive at maturity at once. The evolution of all malocclusion (and this term includes the relative positions of the jaws) is gradual and progressive. Figs. 18, 19 and 20 illustrate the gradual progression of retrusion,

representing a case at eight, thirteen and twenty-two years, respectively. In Fig. 18 the interdigitation of the first molars is sufficient to keep the lower partially held to a correct position, though slight retrusion has set in. In Fig. 19 the narrowing of the upper (see Figs. 11 and 14) is greater relatively than in Fig. 18, and the cusps of the first molars no longer hold the lower jaw at all in proper position. In fact, these very cusps, being long and sharp, and occluding into equally deep depressions, are very powerful factors in wedging the jaw out of position. As there is now considerable difference in width between the upper and lower arches in the first molar region, these molars are forced out of the proper relation to

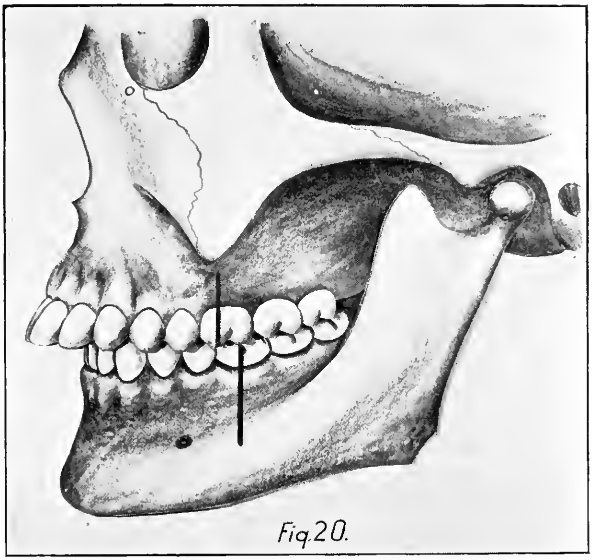


Half developed retrusion, thirteen years.

each other, and the various inclined planes of their occlusal surfaces bring more force than usual upon certain of the antagonistic planes upon every closure of the jaws, thus mechanically tending to wedge the upper teeth forward and the lower teeth backward. The teeth are quite solidly set in the jaws, however, and the tendency would be to move the jaw itself if its resistance to movement was less than the resistance to movement of the teeth themselves within the jaw. As we have seen, the upper jaw is fixed, and therefore remains practically unchanged; the lower is movable, and therefore it is the one to be forced out of place.

In Fig. 19 the cusps of the molars occlude almost end to end, as also

the bicuspids, which at this age begin to be a factor in determining the closure of the jaws. As long as the lower cusps occlude upon the mesial slopes of the cusps of their antagonists, the mechanical tendency is to partially hold the lower jaw forward in place and prevent its moving back, and the process of retrusion is slow; but as soon as the summits of the lower cusps retrude beyond the summits of the antagonizing upper cusps, then every firm closure of the jaws tends to force the lower backward, and everything favors rapid retrusion from then on. Fig. 20 shows the establishment of complete retrusion, and shows also the apparent great protrusion of the upper teeth, which appearance is really mostly due to the retrusion of the lower present. This retrusion also brings the lower incisors to



Complete retrusion, adult.

a position much posterior to where they belong, and where they have no antagonism with the uppers. Following the natural tendency of all teeth to elongate till they meet resistance, these incisors elongate beyond the normal, and in cases of retrusion of long standing are found in close contact with the gum tissue of the roof of the mouth, and in extreme cases may even lacerate it.

Between the thin narrow face of the mouth breather, with the protrusion of the upper teeth and retrusion of the lower jaw, the facial lines in such cases are much distorted, and great inharmony of expression occurs, giving a peculiar look characteristic of the mouth breather, of which Fig. 21 is a partial representation. This expression has been recognized

before, but it has not been sufficiently emphasized in dental literature. In fact, the mouth breather's condition in general has been attributed to many incorrect and even absurd causes, chief of which is that the habit of thumb-sucking is the cause of the dental arches already described, and the inharmonious facial lines of Fig. 21. This piece of inaccuracy and absurdity never had any real foundation for existence, except a hastily formed conclusion, like many other absurdities in dental affairs.

Thumb-sucking.

It is true that the mouth breather's arch is of such shape that the thumb usually will fit it nicely, and it is also true that all children suck their thumbs more or less; but right there all relation between cause and effect stops

Fig. 21

Effects of mouth breathing on facial lines; so-called results of thmub-sucking.

short. The habit of sucking the thumb is common to all children whatsoever, the rich and the poor, the great and the lowly alike, but the arches described are found in mouth breathers exclusively; if thumb-sucking caused the trouble, all children would be affected alike. If thumb-sucking were a cause of the trouble, all temporary arches ought to be affected, whereas it is well known the temporary teeth are almost invariably regular. To affect the shape of the permanent arch the habit must be continued to the time of the eruption of most of the permanent teeth, at least to the tenth or eleventh year; while the fact is, thumb-sucking is a habit of very early childhood, and is rarely continued beyond the second year, or the period when the hands have plenty of other employment. Further, such a habit must needs be indulged in most of the time to affect the dental arch; an occasional indulgence could do no harm, and any continued fol-

lowing of such a noticeable habit would certainly be noticed by parents, or teachers at school, and vigorous means taken to stop it.

In making inquiries of parents regarding the habit in mouth breathing children, I have never yet found a substantiated case where thumb-sucking was present at all to the degree necessary to cause change in the dental arch; the parents sometimes declared their suspicions of the presence of the habit, yet when questioned closely never had actually seen it, except occasionally. The ideas concerning the subject are floating bits of rumor and superstition, equal to the belief that extraction of the "eyeteeth" causes blindness, etc. In any cases where the habit really might exist in connection with mouth breathing, I think it must be assumed in response to the demand for action on the part of the muscles of the jaws, which might find relief in chewing or sucking the thumb, instead of biting the lip, or other similar gymnastics. This is the only reasonable connection I can imagine between thumb-sucking and the mouth breather's arch, and believe such cases must be rare indeed.

Yet this fallacy is to be found in text books, in dental journals, and is always mentioned by somebody at every dental meeting. Only lately has a book appeared, from the city of Boston itself, written by a professor in a dental college, and intended for use in educating (?) the public, in which a cut appears very similar to Fig. 21, and very prominently labeled "effects of thumb-sucking." The time for such stuff—to call it by no harsher name—is certainly past; then away with such absurdities for all time. Thumb-sucking has nothing more to do with producing the mouth breather's arch than has a liking for music, or an appetite for pickles.

The Temporo-Maxillary Articulation.

Another feature connected with retrusion merits notice; the condition of things at the temporo-maxillary articulation, and the effects of retrusion upon development of the lower jaw itself. The details of the relations of the condyle and glenoid cavity in retrusion have not been discussed, and I believe are imperfectly understood. It has been thought, in a vague sort of way, that when retrusion occurs there is sufficient absorption of the fibro-cartilage of the glenoid cavity to allow the condyle to assume a new position posterior to the old. This I once believed and taught, but I am now convinced that this is wrong, after some considerable anatomical study. In this study, I had the opportunity to examine all the subjects in the anatomical laboratory of the medical college of the State University of Iowa, and I and my assistants investigated every temporo-maxillary articulation in the entire lot, some one hundred and sixty in all, hoping to determine the average amount of retrusion possible by dissecting away the cartilages of the glenoid cavity, and accomplishing the utmost retrusion the case would permit. We had many prac-

tically normal occlusions, with some cases of retrusion, but we quickly found that the ordinary amount of retrusion obtained by cutting out the cartilages was but from one to two millimeters, an amount entirely insufficient to allow retrusion the width of an entire bicuspid.

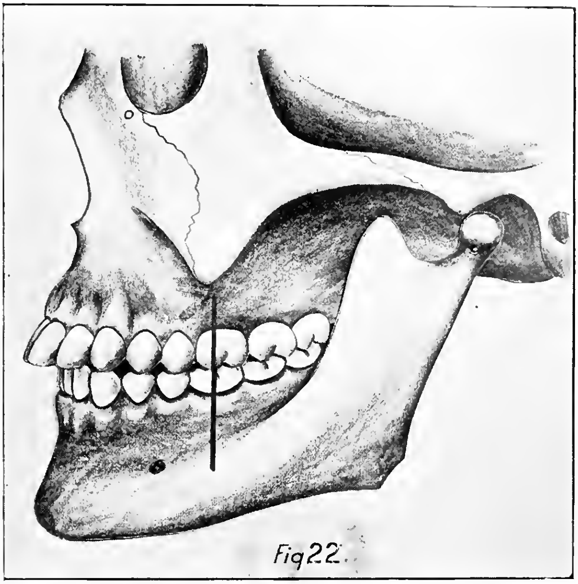
The cases of retrusion showed a position of condyle not to be distinguished from a normal occlusion. In *not one case* did we find retrusion possible to the extent of one bicuspid, or anywhere near it, and while we were not extremely accurate in our measurements (it being a comparatively hurried task on account of the advanced state of the subjects), yet I am certain that the greatest amount of retrusion possible would scarcely exceed two millimeters, and in most cases was not that much. While examination of these comparatively few cases does not fully establish the matter, yet I am convinced we would have found some evidence out of nearly one hundred and sixty cases if greater retrusion was possible.

The great point, however, was the fact that the condyle seemed exactly the same in the cases of retrusion we found, as in the cases where the lower jaw was in normal occlusion, and presumably in absolutely correct position at the tempero-maxillary articulation. In cases as shown in Figs. 20 and 21 it is evident that the condyle does not move back the same distance as the body of the jaw. This must be accounted for either by a change in the shape of the ramus, the moving backward of the lower teeth or moving forward of the uppers, or else lack of full development of either the body or the ramus of the lower jaw itself—or more probably, lack of development of both body and ramus.

Examination of both the skulls of such cases and of the living subject does not show any appreciable change in the ramus in cases of retrusion; such a thing would certainly show where the retrusion exists on one side only, and there we find no practical difference between the retruded side and the non-retruded side; therefore we conclude there is no appreciable change in the ramus. If the lower teeth were moved backward bodily in the alveolar process, and the body of the bone remained as usual, the point of the chin would remain prominent, and there would be but little disturbance of the facial lines; whereas the facial outline is always disturbed in direct proportion to the amount of the retrusion. If the upper teeth were moved forward, there would be plenty of space at the tuberosity of the superior maxillary for the third molar, and most likely space between the last molars, and especially would there be a difference in the two sides where the trouble occurs on one side only; but in fact we find no difference between the two sides in the latter case, and the third molars are just as crowded at the tuberosity in a mouth breather as in any other case. As to the notion that the whole superior maxillary may be moved forward, a few moments study of the articulations of that bone

will show how impossible such a thing is. In such an event the superior maxillary must drag with it the frontal, ethmoid, malar, inferior turbinated, vomer, palate and other bones, which would certainly distort the whole anatomy of the head. Examination of a mouth breather's skull shows no such distortion, and further shows that in case of protrusion of the upper teeth, the change in bony structure is confined almost exclusively to the alveolar process, or at most to the very anterior edge of the maxillæ proper.

The evidence all goes to show that in retrusion the lower jaw itself



Effects of retrusion; condyle impinges on eminentia articularis on protrusion of jaw to normal position.

is undeveloped. It has been shown that everything about the case gradually assumes its form—the development of the maxillæ, the sinuses, the nasal opening, the retrusion of the lower—and the non-development of the lower jaw also gradually occurs as part and parcel of the effects of mouth breathing, the amount of non-development being in direct proportion to the amount of the retrusion. The effects of this are seen in Fig. 22, where the fully retruded jaw of Fig. 20 is moved forward the width of a bicuspid, a thing that is always found quite easy in such a case, as the lower jaw is always found extremely movable in all cases where the occlusion is not correct. Here the condyles impinge on the eminentia articularis (usually giving a grating sensation to the patient). This may be readily detected

by placing the fingers just outside the condyles, when the space behind them can easily be felt through the tissues, and it can easily be seen that the lower jaw is lacking in development.

It may be argued against this conclusion that the lower jaw is given a certain natural impetus to growth, just like any other tissue, and that it will grow just so large and no larger nor smaller, and that the mere fact of occlusion of the teeth has nothing to do with the development of this bone; in fact, that if retrusion occurs, it is because of non-development, not the non-development the result of the retrusion. In answer to this it may be said that the law of modification of growth according to use or disuse pervades every tissue and organ of not only our bodies, but of every living thing as well, and that this universal law can hardly be set aside to accommodate a theory to prove a convenient point otherwise. There can be no reasonable doubt that the normal use of any organ influences its development within certain reasonable bounds, and that nowhere is the plasticity of the bony tissues greater during development than in the bones of the head and face. The lower jaw particularly is subject to outside influences during its growth. The other bones of the face and skull, by virtue of their articulations and close connections in blood and nerve supply, are liable to be affected together in any change, normal or abnormal; the lower jaw has no direct bony articulation with any other bone, and its nerve and blood supply are different in character in that it does not have the direct lateral connections of the upper part of the face with adjoining tissues. In development it seems a law unto itself, and except in cases of downright malformation, the body and ramus seem to develop simply enough to keep the condyle in the glenoid cavity, and no more. If the body is not required to develop forward by the occlusion of the teeth, the connecting bone between body and condyle is not called for, and is developed according as needed, which certainly seems a clear following of the laws of growth according to use and disuse, as prevails throughout the living world.

Treatment of Mouth Breathers.

The influence of the foregoing observations upon the treatment of the mouth breather must be plain in many instances. It is readily seen that early treatment is the most valuable, and in fact is imperative to produce anything like perfect results. If the abnormal arch and nasal tract of the mouth breather are to be reduced to anything like normal, treatment must be begun before the worst stages are reached, and before the period of growth is over, that Nature may still be in a mood to change her work. As before noted, expansion of the arch during the period of growth stimulates development of the bones of the face, and if normal breathing is made possible at the same time, Nature will soon make

amends for her delay, and a normal condition of things begins to appear. Development of this kind proceeds for several years, even long after the dental arch has been fully widened, and really forms the most wonderful and most gratifying result of the whole operation.

The growth of the bones of the face is most active at from eight to thirteen years, and if treatment is undertaken then the best results may be expected. If begun even at fourteen to fifteen years, there are yet four to five years of development ahead in which to catch up with the delayed growth, but if delayed longer, only imperfect results must be expected. By eighteen to nineteen years growth of the bones of the face is practically over, and very little can be accomplished by treatment then. The compressed nasal opening may be enlarged a trifle, but hardly enough to allow free breathing through it. If the treatment is delayed to twenty-five, the faintest hope need not be entertained of any reliable result. Mouth breathing has become a direct necessity to sustain life, for no matter what the throat or nasal treatment, the compressed opening cannot be enlarged, and enough air for breathing cannot possibly pass through.

This early treatment is also necessary to get full development of the lower jaw. As has been seen, non-development of this bone is one of the results of the retrusion almost invariably accompanying mouth breathing, and it takes time for Nature to make up delayed development here as elsewhere. If allowed to stand till the period of growth is past, and an attempt is made to have the lower jaw assume a new and correct position, as in Fig. 22, the condyles impinge on the eminentia articularis to such an extent that any considerable mastication would be out of the question, and it is sometimes actually painful to maintain the jaw in this position any length of time.

The elongation of the lower incisors in such a case is also a source of great difficulty in treatment, as they either must be much depressed in their sockets, or else be ground off on their incisal edges to such an extent as to endanger the pulps, if the case has been of long standing. Unfortunately there is no appliance or treatment yet devised which will operate with certainty in practically reducing these teeth to anything like a normal condition when once badly elongated as under discussion. A small degree of reduction can be successfully obtained, by several well known appliances, but early treatment is the best cure.

Two further features of treatment remain for discussion, which are not so plainly suggested by the observations made. The first is that a normal occlusion is one of the final results that must be obtained for any real or lasting success in any case of this kind. Normal occlusion means normal position of the lower jaw, normal shape of both arches, normal position and function of every tooth and every cusp, and normal pressure

on every tooth during mastication. None of these things can be without the other; none can be lacking; all must be present together. Such a perfect occlusion *only* will be self-maintaining when the retaining appliances are finally removed and the teeth left to themselves to either stay in place or finally drift towards the old positions where natural mechanical forces compelled them to go in the first place.

Normal occlusion must be the final result always in view during treatment. This is next to impossible to obtain unless the case is treated early, and is clearly impracticable in the later stages, though theoretically not impossible. Normal occlusion cannot occur with a retruded jaw, nor can a retruded jaw be coaxed into a correct position if painful to remain therein. In those cases where a normal position of the jaw is hopeless of attainment, there must be a resort to that doubtful expedient of extracting one or more bicuspids. This is simply substituting one malocclusion for another, and usually without change for the better. Sometimes there may seem to be an improvement of the occlusion, but the teeth usually fail to stay in these makeshift positions, and the last end of the case is as bad as the first. Early treatment producing normal occlusion is the only practical treatment, and late operating requiring extracting is usually but change without improvement. The inharmonious facial lines are all left, remaining as an announcement of imperfection. In those cases in which extraction is resorted to where normal occlusion might be obtained by proper treatment, no words can be strong enough to voice our condemnation, nor express our regret for the ignorance back of it all.

The last feature of treatment in relation to these observations is the fact that in addition to securing normal occlusion, the mouth breathing must be entirely done away with to expect any permanency of results. To treat a trouble and not remove its cause is to invite failure. The cause of the mouth breathing is the cause of the malocclusion, and the bottom of the matter must be reached. To not remove the cause is to leave it operating to produce the malocclusion all over again after the teeth have been moved, and the treatment is supposedly completed. Whether or not the inward pressure of the cheeks causes the mouth breather's arch, it is nevertheless certain that slowly and gradually this form of arch returns after treatment, if the mouth breathing is not completely eradicated. Many have been the failures from neglect of the necessary medical or surgical treatment, and the orthodontist must recognize that his treatment is only part of what is needed. He alone cannot succeed. It is true that the orthodontist's work does much to establish a normal condition of things, but the expansion of the arch and the establishment of normal occlusion alone will not cure adenoids nor chronic hypertrophic rhinitis. It is foolish to undertake treatment of such a case, except on the condition that the

necessary medical or surgical treatment also be done, and be faithfully carried out the same as the dental treatment. This much is settled in advance—if the cause of the mouth breathing is not removed, the arch will slowly but surely return more or less to the old form upon removal of the retaining appliances after correction, no matter how long the retaining appliances are worn.

But if the orthodontist cannot succeed alone in the treatment of mouth breathing, neither can the rhinologist do better by himself. The work of the orthodontist is just as necessary to complete the rhinologist's efforts, as the rhinologist is necessary to supplement the orthodontist's work. No amount of curetting or spraying will give complete relief in the narrow and hypertrophied nasal passages of the mouth breather. Removal of spurs of the inferior turbinates only partially remedies matters. What is needed is the intelligent co-operation of both rhinologist and orthodontist, with a better understanding by each of the others' work. Even then they can only succeed in full measure when treatment is given during youth, and Dame Nature, the greatest physician of them all, is simply helped to perform the real cure.

How futile, how utterly hopeless of good results is the treatment of the mouth breather after maturity is once reached. What waste of energy and how many the disappointments from attempting the impossible in this line. How many the failures, and what faith in both orthodontia and rhinology has been shattered, because Nature has been expected to set aside her laws, and perfection has been hoped for from man's crude efforts where only Nature herself could do the work.

The American Society of Orthodontists

Third Annual Meeting, held at Buffalo, N. Y., December 31st, 1903, January 1st and 2nd, 1904

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Third Annual Meeting of the American Society of Orthodontists.

President's Address.

By Dr. Milton T. Watson, Detroit, Mich.

The "annual address" of the presidents of societies devoted to science or art, like funeral orations, had their origin in the remote past, and, unfortunately for you, out of respect for this old custom I purpose to inflict the usual bore upon you even though I may have no more ability to do it well than have some of the men who are called upon to deliver the funeral orations.

This, the third annual meeting of our Society, is another occasion of deep satisfaction to those of the members who were most active in its organization. We think it has been made quite clear to those who have been sufficiently interested to keep at all in touch with our work, that the motives which prompted the organization of this Society were not the result of hasty or immature judgment. As you already know, these motives were the desire for the closer comradeship of those deeply interested in orthodontia, so that the advances in this field might become more widely known and practiced, coupled with the belief that the time was at hand for its establishment as a distinct and exclusive specialty. There is but one other thing that is as essential in bringing about these results, and that is a well-equipped post-graduate school. Whether this school

Reprint from Items of Interest.

should be connected with some of our great universities or whether the best results will come from private institutions is, of course, an open question, the discussion of which I will not at this time enter into, but certain it is that teachings of a radically different nature from those generally in vogue are required before the future acquisitions to the dental profession will have even the faintest comprehension of the science of orthodontia. This is said, not in a spirit of unkind criticism, but merely as an ungarnished statement of the facts. In substantiation of this I may say that prominent college professors and some equally prominent men engaged in private practice, a little less than three years ago, actually ridiculed a man who was about to give up a successful general practice for special work, because they believed it to be a field of such limited possibilities and uncertain results. This belief was but natural, in view of the superficial attention that has been given this work in our colleges.

Orthodontia an Exclusive Specialty.

That orthodontia is a work for specialists and not for the general practitioner is, I think becoming a more generally accepted idea even among the men who have been compelled to attempt it and who have, until recently, been satisfied with the result of their efforts. As a man grows in a knowledge which results from a personal experience, that greatest of all schools, he becomes unalterably convinced, if he is a keen observer, that there is no branch of dentistry which more surely belongs in the field of special work. To begin with, it requires a very high order of artistic sense combined with a capacity for skillful and exact manipulation, and equally important with these must be a love for little children, without which no man can become a successful orthodontist.

I think I am not over zealous when I say that no specialty in the whole realm of the healing art requires more of that particular kind of genius which some one has described as "capacity to take infinite pains." The very secret of success in orthodontia is close attention to the minute details. A still further proof that this work belongs in other hands than those of the general practitioner is the sad results with which we come in contact so frequently; and let me impress it upon you that these "insinuations," if you choose to call them such, are not made against the humble and obscure village dentist, but are applied to men who occupy high social, professional and educational positions, and who have among their clientele people of refinement and education who are capable of appreciating really high-class services—in fact, seem not so slow in appreciating them as we have been in directing their ideas along the proper channels.

It is said that "time alone will correct many of the errors of judgment resulting from too hasty deductions;" and while some of you may look upon this address as a rather severe arraignment, it is, as a matter of fact,

not intended as such but rather as an attempt to convince you that in your efforts and teachings as applied to this work, you have been and are, in a large measure, continuing to make many errors because of a blind adherence to the teachings of the past, which have been very largely the result of hasty and unwise deductions. When orthodontia becomes a thoroughly established and widely practiced successful specialty, its elevating influence upon the profession at large will be such that there will be no further discussion as to the proper time for removing the first molars, nor as to which tooth to extract in order to repair "Nature's blunder" (?) in supplying a child with "large teeth and small jaws." Neither will it be necessary for Cupid to consider the possible evils that may result in the way of malocclusion in future generations should his dart enter the hearts of young men and young women who happen to differ considerably in their physical types.

Influence of the Society.

With an understanding of the early ambitions of this Society, let us glance back a couple of years and see if any really radical changes are noticeable. At the time of the formal organization of the American Society of Orthodontists there were, so far as I am able to learn, but five men devoting their time exclusively to this work. Two of these had been so engaged for a number of years, while the others were comparatively new in the field; indeed, one entered it after the informal meeting at which time it was decided to organize. To-day we find specialists to the number of at least twelve who are devoting their best energies to orthodontia, and at least as many more are putting forth every effort to qualify themselves for special practice in the near future. It is as yet too early to say whether all of these have chosen wisely, but certain it is that many of them have attained success which bears eloquent testimony to this effect.

Three years ago one was compelled to search the periodical literature laboriously to find anything relating to orthodontia, and when he did find it, the chances are many to one that it pertained to such time-honored subjects as extracting or a new complexity of appliances. To-day we have little difficulty in finding literature in the journals upon this subject, and a goodly portion of it is of scientific value. The comments we have received upon the published proceedings of this Society have, from the first, been of a most gratifying nature; and an even stronger evidence of the appreciation of the profession—if such be needed—is the fact that applications for membership are coming to us from nearly every part of the world.

A desire to be perfectly fair and give credit to whom credit is due compels me to say at this point that were it not for the self-sacrifice of Dr. Edward H. Angle and those associated with him in his school the

outlook for this Society's accomplishing its desire would indeed be very much darker, for that school, like any other doing a really scientific work in the teaching of orthodontia, must become the very fountain head of supply for such a society.

Faulty Dental Education.

The subject of dental education has seemingly been worn threadbare, but among the needed advances and of which you have heard little is a broader study and a keener appreciation of facial art. That this is true no thoughtful man will deny, I think, for the inartistic prosthetic work that one's attention is drawn to in his daily minglings with humanity, is proof convincing. The artistic requirements in orthodontia differ little from those of prosthesis, but in practice the following difference seems to exist, that in the latter field the needs are very largely ignored; while in orthodontia these requirements are given the most careful attention by all properly trained men. In a paper before a Michigan Society some two years ago I ventured the prophecy that the day was not far distant when the study of art would occupy a prominent place in the dental curriculum, and I am to-day more than ever convinced that such teaching would be wise. It is simply preposterous that men should attempt the remodeling of a living human face without at least a fundamental knowledge of facial art, when the men who work on canvas and marble devote to it years of study. Yet how vastly more important it is that the artist working on the human being should possess a knowledge of the lines of beauty than the man who reproduces these lines by means of the brush or the chisel. That many of my hearers will think this utterly impractical I have no doubt—neither do I forget that less than three years ago some of these same hearers doubted the practicability of specialists in orthodontia in any city of less than half a million population. Time works wonderful changes.

Art in Dentistry.

That there is a general awakening to a keener appreciation of esthetic conditions as related to dentistry is shown not only by the time devoted to this phase of it by orthodontists and by at least a few prosthetic dentists—judging from the papers recently presented before the Society whose guests we have just been—but also by the general interest which is manifested throughout the dental world in porcelain inlay work. The interest in this latter work must certainly be due largely to the esthetic considerations and not to the fact that it is so much less fatiguing to the operator or that the successful preservation of carious teeth was not possible by older methods. These things indicate to my mind that we are on the threshold of a brighter, higher era of professional attainment and one which will soon eliminate

a number of the distressing methods that have been so largely in vogue in the past and which have mutilated irreparably the masticating apparatus of many an individual, as well as having forever destroyed facial lines that might instead have portrayed beauty of face and strength of character. Chief among these "distressing methods" has been the ruthless extraction of teeth, especially the first molars, which many of us removed unhesitatingly during the palmiest days of our ignorance.

The Orthodontist and the Rhinologist.

The need for a closer relationship between orthodontists and rhinologists has been discussed in this Society before, and is undoubtedly receiving more and more attention not only from our standpoint but from that of the rhinologist as well. Some of the most eminent among their number recognize the interdependence of the two and are directing their patients to have done such work as may be required in order to restore a normal size and arangement within the mouth. They believe that by so doing the patient will have a normal function restored, the effects of which will be far reaching especially in the way of stimulating a normal development in the nasal passages, which carries along with it conditions of the most vital importance to the physical well being of the individual. A rather careful observation in this field convinces me that we will have to modify some of the deductions of the past relative to the association of nasal disturbances and malocclusion of a definite type, namely Class II. Division I. (Angle Classification). Not that these conditions are untrue but rather that the nasal disturbance is also associated with and is apparently a causative factor in many of the cases of malocclusion of Class I. A number of the most pronounced cases of this type have been under my personal observation. That nasal obstruction is always associated with malocclusion belonging to the First Division of Class II. I have no reason to doubt, but to say that it is associated only with this type, I am compelled to believe is an error. I am calling these things to your mind not that I want to elaborate upon them, but in the hope of stimulating you to a closer observation in the future, that we may soon have a vast amount of data at hand from which reliable deductions and conclusions can be drawn.

Physicians who have upon their hands the responsibilities of treating rhinological disturbances have to a great extent overlooked the fact that where oral deformity existed, accompanied by a pronounced inharmony in the relation of the upper and lower lip, that they could not by any possible means restore normal (nasal) respiration until the oral deformity was overcome, so that the patient's lips might close naturally and without the putting forth of a special voluntary effort. The baneful effects of adenoids of long standing, accompanied by pronounced facial deformity,

can be only partially overcome by the mere surgical removal of the growth. The disappearance of the eye and ear complications, if they exist, might be expected, but the complete restoration of the normal function of the nose can only be looked for when the operation is performed early—before this oral deformity has been brought about. If the removal of the obstruction is delayed until the normal development of the jaw has been interfered with, then the patient will require the services of both rhinologist and orthodontist before the function of the nose can be restored, and until this fact becomes recognized by the medical fraternity at large, they will continue to find many cases where the removal of adenoids will result in very little benefit to their patients.

There seems to exist, in the minds of some physicians, and dentists as well, the thought that the practice of orthodontia is really the art of cosmesis rather than an essential part of the great healing art. That it is a practice which deals in no small way with attempts to restore to normal function and normal appearance parts which in themselves are things of beauty and usefulness really adds greatly to its attractiveness as a life work. However, conservative surgery, which looks to the preservation or restoration of disabled, deformed or diseased parts rather than their removal or complete destruction, has never been denied kinship by the parent profession.

The dependence of the rhinologist upon the orthodontist to aid him in restoring normal respiration in long neglected cases of nasal occlusion; the humiliation suffered by the orally deformed; the possible influence upon the development of the base of the cranial cavity of a high vault and a *straight* septum; and the fact that the practice of orthodontia either obviates or overcomes these conditions places it securely in the field of this great healing art.

Returning to matters pertaining to the Society's welfare, I wish to call your attention to one thing in the management of its affairs which I most heartily commend—the elimination of "politics." This is brought about by conducting our elections by mail, and but one thing is necessary to make this scheme a real success, and that is to place in the hands of each member a complete printed list of our membership with the address of each. I most respectfully recommend that the secretary be instructed to do this.

Collection of Models Recommended.

I should also like to see this Society vote a reasonable sum of money for the purpose of securing a fine collection of models and photographs to be presented to the Army Medical Museum at Washington. This collection should be strictly modern and should show the result of the correction of oral deformities without the loss of teeth, both from the

standpoint of occlusion and of facial art. I see no obstacles in the way of securing such a collection, for it is now possible to have models accurately duplicated and in this way men could contribute toward such a collection without depleting their own; and, too, the top and the base of all models could then be trimmed to harmonize, thus adding greatly to the beauty of the collection. Should this meet with your approval, I would be glad to see a committee begin work upon it at once and a certain definite sum of money set aside for its use during the year.

Restriction of Membership.

I have but one further recommendation, and that is relative to the class of men who shall be eligible to membership in the Society. I feel that active membership should, in the future, be confined to men who are either teachers or specialists in orthodontia; therefore, without further discussion on my part, I recommend that Section I. Article III. of the Constitution be thus changed, to take effect at the close of this third annual meeting.

Discussion.

Dr. Edward H. Angle, St. Louis, Mo.

I wish to indorse the President's address and all its resolutions, and I am heartily in sympathy with its spirit. I may be over-enthusiastic sometimes in things that relate to orthodontia, but I feel sure that everything he has said is strictly in accordance with the best interests of our specialty. Some of his recommendations may appear radical, yet I believe they are wise and just.

Collection of Models.

I heartily indorse his recommendation with reference to building up a large collection of models and specimens pertaining to the science of orthodontia, the same to be placed and cared for in our Army Medical Museum at Washington. We must and will have such a collection—one, too, that will reflect great credit upon orthodontia and put to shame all the other branches of dentistry on account of their being so remiss in such matters. Already we have almost everything else represented in our museums, but nothing on orthodontia, notwithstanding that it needs no argument to prove that such a collection would be of inestimable value to dentists and to orthodontists, as well as to mankind generally. Malocclusion is the rule rather than the exception, and we are just beginning to learn how greatly we can benefit mankind by proper and scientific attention to the restoration of the teeth to normal occlusion. I have always looked forward to the time, when I am through with my private collection, that it

would have a place in our Army Medical Museum, where it might benefit some one and save the innumerable hours of labor, trouble and the great expense in collecting that it has been to me. But now, thanks to modern skill, our choicest models may be duplicated without injury to them, so that instead of there being small collections scattered over the country we may have one magnificent and imposing collection if we will but accept our President's suggestion and take measures to carry it out. My entire collection is at the disposal of the proper committee.

Restriction of Membership.

I also heartily indorse the President's recommendation to limit our members to those who are either teachers or specialists in orthodontia. Of course, this doubtless seems radical to many of you, but it is correct, and for the very best interests of this Society. I am sure of it. Already the Society is growing so rapidly that it threatens to become unwieldy and thus endanger the very object for which it was created, namely, the promotion of the specialization of orthodontia. Of course, some will say we ought to admit all who will come to us and encourage all to do better work in orthodontia. Let me tell you that it is my deliberate conviction after wide experience among dentists, and many years as a teacher of orthodontia to dentists, that it is only the few who concentrate their energies on orthodontia who will ever become truly useful practitioners of this branch, and this Society was created that those who are specially interested might have opportunities in accordance with their deep interests; where they can meet and discuss the finer and grander phases of orthodontia and not be encumbered by those who are superficially interested and whose efforts at best can only be those of amateurs and whose questions and discussions must ever pertain to the kindergarten of orthodontia. We do not want men as members unless they are sufficiently well informed to discuss topics bearing on our specialty intelligently. The usual painful, rambling, superficial discussions on orthodontia so commonly indulged in at dental societies are familiar to you all and ought to be the best of reasons why we should eliminate them from the meetings of this Society if these meetings are to be of any value in the uplifting of this the grandest, the most refining, the most artistic, the most scientific branch of dentistry.

I am asked to define what I mean by a "specialist in orthodontia." I will do so with pleasure. He is not a jack of all trades. He is not a would-be universal genius who would pose as authority on all branches of dentistry, but he is one who is in exact keeping with the term—"specialist in orthodontia," or one who limits his professional energies to the study and practice of orthodontia. Such a man knows full well that even this field is ample—nay, more than ample, for his capabilities. By thus con-

centrating his energy he is enabled to benefit humanity in a way not even dreamed of by the occasional dabbler in orthodontia or would-be "do everything" in dentistry.

As yet the number of specialists in this branch is not large, but it is on the increase and I know of not one who is competent who is not doing remarkably well. You will see some striking evidences of this in the work that will be brought before this Society before this meeting closes, and I here predict that there are those in this audience who will live to see competent specialists fully employed in every city of even twenty thousand inhabitants in this country, for certainly the field is limitless.

It is not necessary that we have a large Society. Already we have far exceeded our expectations in interest and numbers. True growth in orthodontia cannot be rapid, neither can a real interest in it exceed real study and real experience. The most vital interests of this Society demand that we shall not have a great Society as measured by numbers, but that it shall be great in interest, in enthusiasm, and in concentration of study, and you men who are careful observers know that this class of men are not and probably never will be numerous. This Society welcomes all who are truly interested in orthodontia, but we do not welcome that class of men that is ever ready to join all societies that promise to be popular; neither do we want that blighting barnacle, the political dentist. So far we have been spared, and the results of his absence in the prosperity of this Society are well-known to you all. There will not be the least difficulty in maintaining a membership fully in keeping with the demands and growth of this science. Let us admit only those who will be a help in the uplifting of our immortal specialty, and then we shall have no fears as to the success of our annual meetings nor of the quality of work done at these meetings. The subjects that we as orthodontists are most interested in can be of little interest to the superficial student of orthodontia—the dentist. He cannot possibly discuss our papers intelligently. Then why should we wish him as a member? He will always be perfectly welcome to attend our meetings, but he is not an orthodontist any more than he is a rhinologist or an opthalmologist or an otologist. The day has forever passed when the orthodontist and the dentist shall be the same. Orthodontia has grown too great, and so has dentistry. Let us each specialize, as we should. Let each organize, as he should. Let us no longer be jacks of all trades and masters of none, but true specializers and students of our specialties.

Dr. N. S. Hoff, Ann Arbor, Mich. Your President has opened up a great many questions for discussion, and if I should speak upon all the points I fear I should be occupying more than my share of time. The doctor has said many things

that we, as general practitioners, do not appreciate, but I am convinced that he means what he says because I know him to be an earnest worker and firm in his beliefs. His idea in regard to establishing a national exhibit at Washington is a very good one, and if you will allow me a suggestion, I would say to go a step further and prepare another set of models for exhibition at the World's Fair in St. Louis. I think that would be a splendid opportunity for the orthodontists to show the world at large what they are doing, and I am certain that the majority of professional men in this country are not cognizant of what is being done in orthodontia by a mere handful of specialists in the branch. Orthodontia is a science by itself, a new branch of our profession, and it seems to me that this would be the proper time to show what progress has been made in a comparatively few years. I do not know of any way in which that could be done more effectively than to prepare an exhibit for the World's Fair. If you should so desire that collection could afterwards be placed in the Medical Museum in Washington, but so far as I am concerned personally I feel that such a collection should be placed where it would do the most good, and that is in the teaching institutions of this country. It might not be feasible to donate to each dental college in this country such a collection, but if it could be placed at some point where it would be accessible to all the colleges, I am sure good use would be made of the collection, more so than if the collection were placed in Washington, where but few people would see it.

Dr. Watson also touched upon a matter that has appealed to me for a long time, one which I hope will be discussed fully, and that is the individual qualities or requirements that are essential to make one successful in this specialty. In my judgment there are very few dentists who have the peculiar temperament that is necessary, that absolute control of themselves which brings with it success. Your President said, and truly, that it requires close attention to details. He also said that it required a love for children. I do not think that that is quite so necessary, although that is a very happy faculty to possess. I believe that the man who engages in this work must have not only technic ability and love for details, but he must have a strong character and individuality such as will keep him loyal and faithful to his work; that will enable him to carry out his plans in the most expeditious and successful manner. One of the great drawbacks in this work is the length of time that is required for a successful treatment of most cases that come to the orthodontist. Patients get worn out physically and become disgusted with the work, often giving it up completely. So that it is essential that a man have right ideas in the beginning as to what is wrong, what is to be done, and how it should be done. Take hold with the determination of doing it in the shortest period of

time and to the best of your ability, always keeping in mind the comfort and interests of your patients. That, it seems to me, is the particular element of character that is absolutely necessary in one who engages in this specialty. Some people do not know when a thing is completed. They simply go along until they reach a point where they feel that the work is good enough and then drop it. We have all seen many exhibitions of that kind of work in all branches of dentistry and appreciate the need for something better.

Dr. A. E. Webster, Toronto, Can. I was very much interested in the paper, especially that part which referred to the keeping of models in the museum. I agree with Dr. Hoff that it would be very desirable to have a museum of that kind in every college, but it would be worthless without well kept records. I have taken some pains to try to keep a record of our school work for that purpose. It would be better to have the best specimens of work done kept in one place, where they might be held as a record for all time. Colleges may be destroyed by fire or pass out of existence, and in that way these specimens would be lost; while if placed in a national museum they would be preserved. Yet it is very desirable to have them in the colleges. In our school we keep accurate records of the class work, and we can refer at any time to anything done in the institution in orthodontia.

Another point brought out by Dr. Hoff was the necessity of exactness in work. Any person possessed of the natural instinct of looking after details will succeed in orthodontia. I have not seen many students possessed of those characteristics. They often do like the patients—become enthusiastic up to a certain point and then flatten out. Very few men have the courage and perseverance to carry the work on to a successful issue. Then we must also consider the patient. Patients differ in their tenacity of purpose and a man who has not the ability to control his patients should not undertake orthodontia at all.

Dr. Geo. H. Wilson, Cleveland, O. It certainly is a pleasure to meet with this body because this is a new era in dentistry; it has to do especially with the esthetic side of dentistry. The president has made some very important recommendations and suggestions, but there seemed to be a spirit in the paper that this organization should withdraw from the profession as a whole. That would be a great mistake, because this organization is a missionary, in a sense, with a great work to do for the profession as well as the public. The profession at large has much to learn that this organization can impart. Take, for instance, the extraction of teeth. Nobody is better prepared to impress upon the profession the many injuries that accrue from the unnecessary extraction of teeth. So you have another object to keep

in mind other than the gathering together of men who are especially or solely interested in this specialty. Of course, there can be no question but that the active members of this Society should be especially interested in orthodontia, but you should use your influence to draw in the others; you should educate not only yourselves but also the mass of the profession.

Although I am not a member of this Society, yet I trust I will be before the end of the session. I never expect to practice orthodontia, but nevertheless I am interested in the work of this Association because I feel that it is a man's duty to take up a special line of work and confine himself to it. I have a scientific interest in this work because I am a teacher, and I expect to profit very much from the work of this Society. I am very thankful to you for the privilege of discussing the paper.

Dr. Hawley, Columbus, O. I was very much pleased with the address. There is not a recommendation in it that we cannot indorse fully. I have been interested in orthodontia for many years, and it is a source of great pleasure to me to see the rapid strides that this specialty is making toward perfection. The work of this Society will have an important bearing on all departments of dentistry; perhaps more than we imagine at this time, and the principles that will be promulgated in this work will be lasting.

Artificial Substitutes for Missing Teeth in Orthodontia.

By Hart J. Goslee, D.D.S., Chicago, Ill.

Were it not for the assignment to me of the title for this paper, I should much prefer to designate it "A Few Principles and Methods in Crown and Bridgework as Applied Particularly to Orthodontia;" but I am so appreciative of the courtesy which has been extended to me, and of the privilege which I now accept, that I would regard changing the title an unbecoming presumption, and one which would scarcely express my high regard for this body, and for the grand work which it has accomplished during its brief existence.

If it were not for the *art side,* the profession of dentistry might properly be regarded as but a specialty of medicine. The requirements and possibilities along this particular line, however, make it of necessity a distinctively separate profession; and an appreciation and development

of these has enabled it to assume its present high position among the arts and sciences of modern times.

What the specialty of crown and bridgework has contributed to the development of the *art* in dentistry, the later advent and marvelously rapid development of the specialty of orthodontia has in turn contributed to its *scientific* advancement. Thus do we find these two important specialties, embracing individual fields of usefulness, closely related to each other, because of having been stepping stones as it were in the progress of the profession, and in its establishment to the position which it now occupies.

If this relationship should be regarded as a more or less sentimental one, we need only to think of the closer ties which exist because of what the one requires of the other, and what, in the language of the founder of this Society, "must be more and more required, and continue to be required as modern orthodontia is better appreciated and more intelligently practiced."

In the almost unprecedented development of the specialty of orthodontia, and with its establishment upon broad and sound scientific principles, we have come to learn, and to appreciate, the great importance which must be attached to the possession of a full complement of teeth, or its equivalent, and to the establishment and permanent maintenance of their normal relations.

We have learned that these conditions are not only essential to the proper mastication of food, but also, and of almost equal importance, that they are essential to the proper production of the vocal tones, and to the art relations which may bring about harmony, and thus in turn be productive of typical and normal physiognomy.

The achievements already made in the practice of modern orthodontia have afforded this revelation, and the practical application of the science now readily admits of the readjustment and rearrangement of abnormal relations in such manner as to bring about these infinitely desirable results.

Here, however, is where the true relationship between the specialties of orthodontia and crown and bridgework, and the dependence of the one upon the other, are manifest, because it is also recognized that a preservation of the conditions which have thus brought about comfort and usefulness, harmony and relief from disfigurement, can only obtain permanently through the establishment of normal relations, and that this may only be accomplished by the substitution of artificial teeth for those which are missing, and which, in many instances, are the abiding cause of malocclusion.

It would seem but reasonable to look to crown and bridgework for

methods of procedure most applicable to a large proportion of cases, by which means we may be enabled to conserve to the highest degree of artistic and mechanical requirements, and at the same time hope to obtain, the most favorable prognosis in the replacement of these missing teeth.

The problem, however, as to how best to replace those teeth which have been lost through what may properly be termed criminal negligence, or those which are missing as a result of non-eruption, or lack of tooth germ development, is always, and necessarily so, a serious one, for at least three reasons. *First,* we must of necessity involve the possible integrity and longevity of adjacent, perhaps sound, teeth. *Second,* because the replacement is usually indicated at such an early period in the lifetime of the patient as to demand that a maximum degree of permanency be obtained from the method adopted. And, *third,* our efforts are confined to environments which present so great a diversified range of conditions as to preclude the adoption of any one general line of procedure.

First Molars.

The teeth which are most generally lost as a result of the ravages of decay, and ignorance or indifference on the part of parents or guardians, are the first molars—the keystones of the arch—those particular teeth, the presence of which is so essential to the maintenance of the normal relations of all of the other teeth in the denture; and, further, those teeth which are situated in the immediate center of the masticating area, and which must thus necessarily receive such a degree of masticating stress as to usually demand a maximum element of strength and durability in the artificial substitute.

Unerupted Teeth.

The teeth which are most frequently missing through failure to erupt, or because of lack of tooth germ development, are the lateral incisors and bicuspids, and in these cases, where the same requirements of stability in the substitute are so apparent, we also demand higher esthetic results because of the fact that they are within the range of vision.

A recognition of the fallacy of the former practice of sacrificing a corresponding tooth in the same arch to compensate for the loss of another, and as a means of correcting the malposition, has demanded the replacement of such teeth as may thus be missing, even though the replacement may necessitate the expenditure of time sufficient to gain adequate space, and be made even at the expense of a possible injury to the adjacent tooth or teeth, which must be utilized to support the substitute.

The problem which confronts us in considering the replacement of such missing teeth in a manner which will conserve to the highest esthetic and mechanical reauirements is, in my opinion, altogether one of the *methods of attachment* which may be indicated and employed.

Dummies Attached to a Single Tooth.

As applied to supplying missing teeth, anterior to the first molar in either arch, it is my belief that we can accept as a cardinal principle this assertion—that one tooth *under favorable conditions* may be expected to perform the function or to do the work of *two*. The provision designated as "under favorable conditions," however, would necessarily make one general requirement, and one emphatic exception.

The requirement would be that there should invariably be observed some means of preventing the rotation, on its long axis, of the tooth used as the abutment, which would likely result because of the leverage afforded by the suspended substitute; and the exception would be that the abutment tooth must possess a degree of stability *greater* than that required of the missing tooth.

An analysis of this fundamental and mechanical principle would compel us to conclude that it would not be practicable to expect a lateral incisor alone to support a central incisor or a cuspid; a *first* bicuspid to support a *second* bicuspid, or a second bicuspid to support a first molar, because the requirements of the tooth thus supplied would exceed those, and the consequent stability, of the abutment tooth itself.

On the other hand, however, if the occlusion is, or may be made, favorable, we can rely upon the central incisor or cuspid to support a lateral incisor; a second bicuspid to support a first bicuspid, or a first molar to support a second bicuspid, because in these instances the abutment tooth naturally occupies a more favorable location in the arch to withstand stress, and possess a greater degree of stability than would be required of the missing tooth, which is thus suspended. In all of these instances, however, the suspended tooth must not be allowed to act as a lever, and thereby produce a possible tendency toward the subsequent rotation of the abutment tooth.

And, further, as the power of the lever increases in proportion to its length, or the distance between its extreme end and the fulcrum, and as the abutment tooth becomes the fulcrum, whenever more than one tooth is to be supplied, a *secure attachment upon each end* is always an absolute requirement.

In the treatment of such cases as frequently present themselves to the orthodontist, I am free to confess that the problem as to how the desired result may be best accomplished is at all times a difficult and perplexing one.

It is to be so regarded for two reasons. *First,* because of the fact that the required procedure is usually indicated at such an early period in life as to demand such a form of substitute as may reasonably be expected to afford the desired esthetic effect; to certainly maintain the space,

and further to answer the purpose of mastication, in a manner which will necessitate or result in as little injury to the teeth used as abutments as possible and consistent with the requirements, and in a manner which will also offer the greatest possible degree of strength and permanency. And, *second,* because of the previously mentioned fact that no one method of procedure may possibly be regarded as universally applicable.

Hence, since this particular subject has thus necessarily resolved itself into one of *methods of attachment,* a consideration of these, preceded by the few cardinal principles already submitted, will practically cover that which may possibly be expected of me in its presentation at this time.

Supplying Lateral Incisors.

In supplying missing lateral incisors, the methods of attachment which may be employed to the best advantage in fixed bridgework may be divided into two general classes: those which involve the devitalization of the pulp in teeth which are to be used for abutments, as a means of affording accommodation for the root-wise reception of a dowel in their canals; and that class of procedures wherein the attachment may be made to the crown of the tooth without necessitating the destruction of the vitality of the pulp, and, in consequence, with a minimum of injury to the crown.

In the former class the attachment may be made by two modes of procedure: Either by sacrificing the crown of the adjacent central incisor or cuspid, and replacing it with an artificial substitute; or by involving only the lingual surface of the natural crown, and using an inlay and dowel.

Artificial Crowns.

The practicability of sacrificing the natural crown of a tooth for the purpose of replacing it with an artificial substitute as a means of affording opportunity for the attachment of the tooth to be supplied is always, particularly in early life, and especially because of the probable incomplete development of the root, to be regarded as a serious problem.

While it is true that such a procedure will invariably offer a maximum degree of stability in the attachment, and of permanency in the operation, yet, in my opinion, it is warrantable only in proportion to the accuracy obtained in the adaptation of the artificial crown, and of the degree of esthetic perfection achieved in its adjustment.

We do know that a good, well made, artificial crown, which has been accurately fitted to a central incisor or cuspid root, and which is then further provided with a rest against the lingual surface of the adjacent natural crown, to prevent rotation, will carry a lateral in a manner which justifies a prognosis of reasonable permanency. Yet whether this seemingly ruthless destruction of the natural crown for this purpose, and particularly

in the mouths of patients of tender years, is warrantable or not, is largely a question which may only be determined by the discretion and good judgment of a conscientious operator.

If there be caries in, or other disfigurement of, such natural crowns, then such a procedure may be indicated, irrespective of age, but otherwise I am of the opinion that less radical means should usually be employed, principally for the reason that this particular mode of procedure may be then observed at any subsequent time, or after the possible ultimate failure of some other method of attachment.

Inlay and Dowel. A less radical and more or less secure means of attachment for such teeth may be obtained from the insertion of an inlay of gold, or of platinum alloy solder, into the linguo-approximal surface of the tooth to be used as the abutment, supplemented with a dowel extending a short distance into the canal to preclude its displacement, and in further combination, of course, with a rest to prevent rotation.

While the destruction and removal of the pulp is also indicated in this method, and while some discoloration of the crown may result in consequence, still, such a procedure is infinitely less radical than the former, in that the natural crown is preserved.

The success of this method of attachment will depend upon cutting a cavity of suitable proportions to carry the margins to immune or self-cleansing areas, or to a point beyond that of contact with the artificial substitute attached thereto, and of proportions which will cause the inlay to possess sufficient rigidity and strength to insure adequate integrity, and will further increase, of course, in proportion to a definite observation of these requirements, and of the accuracy of the marginal adaptation between inlay and tooth structure.

In considering the methods which have been designated as belonging to the latter class of attachments, wherein but little, if any, material destruction or mutilation of the natural crown is required, we come to that class, of course, which would seem to involve the ideal procedures as applied particularly to young patients.

Among many variations of methods of this class, we have at least three which may be found to be often applicable, and wherein their employment may be made more or less artistic and serviceable. These consist of a plate accurately conformed to the entire lingual surface of the natural crown, and sustained and protected against displacement by the use of small vertical pins—the so-called Carmichael attachment—and open face crowns.

Lingual Plate.

The close adaptation of a plate of pure gold or platinum to the entire lingual surface of the crown of the tooth used as the abutment, fortified against the possibility of displacement by having two small pins pass through it and into the tooth just far enough to insure stability, without impinging upon the pulp, and the whole then adequately reinforced, offers a method favorable both to the artistic requirements in, and to the durability of, the substitute.

Where the margins of such an attachment may be brought to a point offering favorable immunity to the lodgment and accumulation of food products, and where the occlusion of the opposing teeth will, or may be made to admit of ample reinforcement to insure strength, this method seems to offer opportunities for esthetic and practical results, in quite a large number of cases.

To obtain such results, however, these two requirements are essential, and must be observed, as must also the aforementioned provision against rotation. This latter may oftentimes be obtained to better advantage by the use of this attachment upon each end of the suspended tooth.

The method seems more particularly applicable, however, to the incisors than to the cuspids, because their location offers increased opportunities for securing the required adaptation of the plate and pins, and because of the nature and direction of the stress received by these teeth.

"Carmichael Attachment."

The so-called "Carmichael Attachment," which is similar, if not identical, in principle to the "staple crown," may often be successfully employed, particularly in making the attachment to the cuspids. It is also applicable to bicuspids and molars, and sometimes to the incisors when a shape obtains which is more or less favorable to their accurate adjustment.

While the employment of this or of a similar method involves a slightly more radical preparation of the natural crown than the former procedure, still this is often warrantable because of affording the increased degree of stability which is required by the location of these teeth, and by the nature and direction of the stress imposed upon them.

When the approximal walls have been properly paralleled, the grooves cut a sufficient depth, the adaptation made with accuracy, and a *uniform* reinforcement adequate to insure the desired degree of stability then obtained, this method of attachment, when employed in connection with the other requirements mentioned, will afford results of an artistic and usually permanent nature. It is presumed, however, that the method may not be generally employed because of being a patented process.

Open-face Crowns. It would probably be almost impossible for one to deal with a consideration of the subject of attachments for fixed bridgework without making some reference to the application of the so-called open-faced crown. Whilst it is true that its application involves less preparation or mutilation of the natural crown than any other, it is not always also true that this uninjured condition remains permanently so under such crowns.

At best they are inartistic to a high degree, because of the necessity for encircling the crown of the tooth supporting them, and yet if the esthetic or art side of the requirements may not be paramount to that of possible strength; if the tooth be properly prepared so as to admit of an accurate adjustment at the gum line, and if a crown be so adjusted and then adequately reinforced, they will support the lateral in a more or less permanent manner, when the precautions against rotation have been also observed.

In view of the above more decidedly esthetic methods, however, ana because of the injury to gum and to tooth tissue surrounding and beneath them, their employment is only to be recommended in extreme cases at best, and perhaps even less often in the mouths of young patients.

Lingual Rests. In calling particular attention to the necessity for overcoming the leverage produced by suspending one tooth from another in the direction in which stress is applied, and in so strongly recommending the almost universal need for the employment of a suitable rest for this purpose, even in the anterior part of the mouth, I am not unmindful of the possible criticism which may reasonably be made in regard to such a method of construction.

And yet you will doubtless agree with me in the correctness of the principle I have enunciated with regard to when and where one tooth may be expected to do the work of two, and also in the absolute necessity even under these conditions, for a mechanical means of overcoming leverage. Hence the practicability of a rest resolves itself into a consideration of the requirements of the same, from a practical and hygienic standpoint.

Their practicability or impracticability depends upon, *first,* an adjustment which will not interfere with the occlusion of the opposing teeth, or impinge upon the soft tissues; *second,* an adjustment which will be so free of contact as to maintain as nearly a self-cleansing space between it and the tooth and gum as possible; *third,* a minimum contact with the tooth at the desired point; and, *fourth,* sufficient rigidity to withstand the stress imposed.

If these requirements are observed, such a rest need not afford much, if any, opportunity for the occurrence of caries at its point of contact;

need not be appreciably unhygienic, nor even an impediment to speech nor to the movements of the tongue.

Supplying Bicuspids and Molars.

If the problem under discussion is to be regarded as being a difficult or perplexing one, as applied to the anterior teeth, it is even more so in its application to the posterior teeth, for while the esthetic requirements may not be so great, the mechanical are even greater.

For this reason, and in line with the principles formerly mentioned, the only space posterior to the cuspids where the missing tooth may be suspended without some secure means of attachment *at each end* is the first bicuspid.

This particular tooth may usually be suspended from the second bicuspid if a rest against the cuspid is provided, and the strength and permanency of such a procedure may be increased by having no definite occlusal surface to the suspended tooth. This latter is ordinarily permissible, because, as a rule, such teeth do but little, if any, actual masticatory work.

If for any reason, or because of more favorable indications, however, the attachment of these teeth should be made to the cuspid, some secure means of additional attachment must be made on the second bicuspid, in order to overcome the combined and increased influences of both *direct* and *lateral* stress.

In supplying bicuspids and molars, two general methods of attachment may be employed: Full crowns and partial crowns, used either in combination with each other, or in conjunction with a more simple, and yet adequate, *rest* at one end.

Partial Crowns.

When the principal attachment may be made to the bicuspid teeth, the employment of a partial crown which will not necessitate an extensive mutilation of the natural one is, of course, always preferable.

A form of partial crown, similar to the so-called "Carmichael attachment," may often be successfully employed by simply paralleling the approximal surfaces and grinding down the lingual cusp, thus forming a solid seat or base for the attachment, and admitting of the restoration of the cusp with gold in a manner which may possess adequate strength and yet not be conspicuously objectionable.

While this method is also applicable to molar teeth, it is more particularly so to the bicuspids, because the same opportunity for securing adaptation is not usually afforded in its adjustment to molars.

Another form of partial crown which may be sometimes indicated and successfully employed on bicuspids, and particularly those of the

lower denture, involves covering only the occlusal surface to an extent which would insure adaptation and integrity in the attachment.

In constructing such an attachment, however, accommodation for the occlusion must first be made, and while the buccal surface of the crown may then be trimmed away until it is not objectionably conspicuous, the lingual surface should extend down as far as the bulbous portion will admit of adaptation, and the approximal surfaces of the crown should extend below the point of contact with adjacent teeth—both natural and artificial—in order that the marginal edges may receive the immunity from the lodgment of accumulations which is afforded by the interproximal space.

Full Crowns. When applied to the molar teeth, there is no form of attachment which offers the same opportunities for successful usefulness and permanency as does the full gold crown, and hence wherever it may be indicated and employed, the best possible results will usually obtain in every respect, excepting, perhaps, that of cosmetics.

As applied to teeth in the mouths of patients of tender years, however, I am of the opinion that such crowns should never be allowed to encroach upon the gum tissue, and that no effort should be made to pass the band beneath or within the free margin of the tissue, thus encompassing the entire natural crown, unless the age and indications may warrant the devitalization of the pulp, and thus admit of a degree of mechanical preparation which will in turn admit of an accurate adaptation at this point.

If the condition of the tooth or the age of the patient contraindicates this procedure, I believe that a more permanent operation, and a more perfect result, will obtain by allowing the neck of the tooth to remain exposed which will in no manner interfere with the usefulness of the artificial crown, if it be properly adapted. By this means the adaptation will be facilitated; injury or irritation to the tissue will be avoided, and normal conditions will remain.

Occlusal Rests. In supplying one or even two missing teeth, any one of these preceding methods of attachment, made in accordance with the prescribed or required indications will often afford adequate anchorage for one end, if the other end is then properly supported.

While in some instances it may be possible and even preferable to employ some one of these attachments *on each end,* yet there are many instances where a simple *occlusal rest* upon one end, or the other, in combination with such an attachment, will afford all the support which the requirements demand.

This may be accomplished in a manner which will require but little destruction or mutilation of the natural crown; which will offer adequate resistance to lateral or direct stress, and which will yet afford an esthetic effect, by making or utilizing a cavity in the approximo-occlusal surface of such natural crowns, filling and finishing it in a permanent manner, and then cutting a seat in the filling which will accommodate the projecting end of a heavy bar from the bridge.

If this projecting end should be of a square iridio-platinum wire of proper gauge, and the seat in the filling so made as *not to involve any of the margins* and of a shape which will admit the projecting end to rest firmly and snugly in position in it, no effort need be made to attach it more securely. Indeed, if the projection fits into the filling and rests more or less firmly therein, the slight mobility thus afforded is in many instances an appreciable advantage, and offers greater opportunities for permanency than if it were securely anchored in the filling.

While the possibilities of such a support are sufficient to often warrant the cutting of cavities in sound teeth, the method is particularly applicable when a cavity already presents.

In conclusion I desire to state that the methods which have been herewith reviewed and considered are those which are exclusively applicable to fixed or stationary operations, which class of procedure I believe offer the most favorable opportunities for success and permanency, whenever the pernicious practice of simple bands is avoided, in supplying missing teeth as applied to orthodontia.

Discussion.

Dr. Edward H. Angle, St. Louis, Mo.

Those of us who give all of our time to the practice of orthodontia know full well that the subject of missing teeth is a very important one, and I am sure it is one that will grow in importance as orthodontia grows, for it is one of the natural difficulties to be overcome in orthodontia, and will be, just so long as ignorant or unscrupulous dentists are given the charge of these priceless organs, and just so long as carelessness on the part of the patients results in the inevitable loss of their teeth.

To the ignorant a tooth is "only a tooth"—only a unit in thirty-two, and something which if it gives offense should be "plucked out." But to the orthodontist its great value becomes apparent and its loss the occasion of our most difficult problems, for it is not only its individual loss, but its relation to all other teeth, not alone in its own arch, but in both

arches, that we have to consider. It is of more importance than is the keystone in masonry, not only on account of its maintaining the size of the arch, but also on account of its maintaining that delicate harmony of the entire series of inclined planes of the dental apparatus.

Given a case in orthodontia with the full complement of teeth even though in quite pronounced malocclusion, and the prognosis becomes easy and the plan of treatment simple and now well understood, for we now know that the full complement of teeth is highly essential to the normal contour and most artistic outlines of the face. But when a tooth is missing, the entire balance and harmony both in the art relations and in occlusion are seriously disturbed, and the problem of how best to restore this tooth becomes a really serious problem.

If we dealt only with people in middle or advanced ages of life then the mere improvement of the occlusion by adjusting the teeth that remained might answer, but we must remember that our patients are usually those of eight, ten, or twelve years of age, and that every effort of culture, refinement and beauty is being put forth in their behalf, and it becomes our duty not to temporize but to do that which is in nearest accord with the ideal in Nature's demands; hence the missing teeth must be restored. It is not optional; it is imperative. If the spaces for these missing teeth be closed, either partially or fully, these spaces must be regained and the teeth replaced. Now to replace these without injury to the natural teeth, and so that they will fulfil their difficult duties throughout a long life is a question most perplexing, and for this reason I am very glad that this Society has secured such masters of this branch of dental science to enlighten us on this very important and extremely difficult problem, for difficult I am more and more convinced that it is. But I must confess to you that these papers have conveyed to me a feeling of sadness—not that they are defective in their composition, nor that the principles they advocate are not the best, but still I am impressed with how far short of the natural priceless organs the substitutes fall, at best. I cannot discuss their relative values, for it is out of my line. This is a specialty in itself and one that the orthodontist cannot practice successfully and should never attempt. It only proves the necessity for specialization and of referring our patients who need their services to these masters. But more than all, I am profoundly impressed with the importance of guarding with jealous care each tooth, that it shall not be sacrificed.

When men shall know occlusion then they will be so impressed with the importance of each tooth that it will be regarded, as it should be, as a punishable crime to carelessly sacrifice them, and they will also know that if they must be lost through the carelessness of the patient that this

does not end it—that they must be replaced unless the entire dental apparatus is to be seriously impaired.

Dr. Geo. H. Wilson, Cleveland, O.

It has been a source of great pleasure to me to have had the privilege of hearing such a very valuable paper, and I am proud also that I am a prosthodontist, a fellow craftsman of the essayist's. It is evident that man has degenerated to such a degree that mortal man has to repair what the Creator is supposed to have done perfectly. But as that is our mission we must answer the call to the best of our ability. How that is to be done is the question we must solve. I believe that the method that has been depicted here today is the best in childhood that can be improvised. What is to be done after the child has reached maturity is another matter. In the early part of this work the crown and bridge method is the only one on which we should depend, although this attachment can last but a few years before the teeth are in a more fixed condition, the parts have developed and the patient is old enough to use an artificial appliance with judgment. Then I believe that a plate is preferable to a continuance of the bridge work, extending the attachments still further than we did originally. Therefore I believe that that is the best solution we have at the present time, and I desire to specially compliment the author on his valuable production.

Dr. R. Ottolengui, New York City.

It seems to me that Dr. Goslee has addressed us as orthodontists almost solely in his title. He has brought to us admirable methods which are not, however, applicable to our work as we meet it. The point is this: We are told how to replace a missing first permanent molar. One method is to make use of the second permanent molar as an abutment. But that is not always possible; often the second permanent molar is not fully erupted until after the orthodontist's work is finished; consequently that process is not applicable to so young a child. Again, we are told how to supply a missing lateral incisor. In the orthodontist's practice lateral incisors usually are not missing as the result of extraction nor lost through disease. We meet that in adult life and we may then restore them according to the methods described. Usually when the lateral incisor is missing in a child it is due to lack of germ development. The case may come to us before the cuspids have erupted. The cuspid is often the last tooth to erupt during the time when the orthodontist is at work; consequently the cuspid cannot be used as an abutment when we are dealing with a young patient.

It seems to me that in a young mouth all the modes of treatment advised are wrong because they are all fixed bridges, whereas, something removable would be cleaner, more hygienic and less likely to cause injury

to the adjacent teeth. There are, perhaps, no real good methods available for the restoration of missing teeth in children's mouths. The work is admirable as related to the adult mouth, but apparently it is not widely applicable in the mouths of young people.

I disagree with Dr. Goslee relative to the Carmichael method. I cannot believe that with any other method at our command, it is excusable to cut grooves in a healthy tooth. In all the methods where cavities are to be cut for rests and attachments, remember that we are dealing with teeth too young to permit of any extensive cutting on account of the size of the pulps during adolescence.

Dr. Goslee has brought us an admirable paper and has attempted to bridge the chasm between the orthodontist and the prosthodontist, but he has not quite done so.

Dr. V. E. Barnes, Cleveland, O.

I have listened to this excellent paper and its discussion with much pleasure. Dr. Ottolengui has touched on some very vital points. Personally, I feel that it is wrong to put bridges on young patients, particularly those under sixteen years old, and in most cases that is far too young. The pulp cavity is as yet imperfectly developed, and if we attach bridges to such teeth, we have thermal changes and induced conditions that are not normal. We should wait until the patient is older; until the teeth reach full development and when the artificial conditions will not affect tooth structure so much as they do in these young patients. When we get through with our little patients of nine or ten or under, we should put in a temporary retaining appliance such as bands and wires or a little plate; or first the former and then the latter and later on the bridge. In this way we may be able to stave off the loss of teeth that must come later on.

The Doctor uses the word "permanent" in regard to these bridges. I believe that is a misnomer, because fifteen years is really a very long average for the life of a bridge. Will the Doctor tell us at what age he would put on these bridges, for he did not touch on that point in the paper, and to us it is a vital one.

Suppose such a case as I have encountered: a girl of twelve years, having all four laterals missing (X-ray shows no germs present), and the bone formation is such that no sightly closing up of the space can be accomplished. The insertion of artificial teeth seems essential and yet you certainly would not think of putting in a so-called permanent bridge at that age.

I cannot agree with the criticism on the Carmichael bridge. It seems to me that a tooth with the least amount of metallic covering has the greatest opportunity for long life, and that is where the Carmichael bridge

is of advantage. I believe that it is a good thing when it is made properly. It is much better than the band or the shell crown.

Then there is the question of movable or fixed bridges. It would seem that, since a tooth in normal position is in a movable socket, our restorations should be along that line and not rigid. Many bridges are lost on account of rigidity. If we have the flexibility that the essayist speaks of we have something to be commended. There is urgent need of something far better than what we have at the present time. It is hard to have to use artificial substitutes, knowing that they are an evil; even that they are a lesser evil, still the best is none too good.

Dr. A. E. Webster, Toronto, Can.

One feature of this subject has not been touched upon, and that is those peculiar cases, for instance, where the first molar has been extracted and the second tipped forward in a patient of thirteen or fourteen. The incisors and bicuspids have been retruded and space must be made. To make any appliance that would be permanent would be a questionable procedure. It is doubtful whether it is to be permanent or not and yet any removable appliance is wholly useless in most of these cases. Can you depend upon a child of fourteen or fifteen to wear a removable appliance? It will be put in and out and forgotten and lost, and in three months or more they come back saying that the appliance was lost months ago, and on examination you find that the conditions are the same as they were when you began to treat the case. In a child of that age a temporary retaining appliance is to be preferred. Even if the second molar is to be crowned and the second bicuspid also, I should not advise crowning nor that the band reaches to the gum line. But some appliance ought to be devised that will be a fixture and that cannot be removed, and which yet does not mutilate the teeth.

It has been suggested that after twenty a bridge or other artificial denture may be supplied, but at that time it is impossible to use a removal appliance.

Dr. Goslee.

I am exceedingly pleased with the reception of my paper, but, with Dr. Angle and others, I confess that I too am disappointed in it. I see now that the subject might have been treated to much better advantage in so far as this particular Society is concerned. It should better have been considered under two heads; one involving the procedures indicated under the age, say of fourteen, and the other involving procedures indicated in the mouths of patients above that age.

In justice to my paper, however, and to the methods which were presented, I wish to say that every one mentioned is particularly applicable to the latter class of patients. Indeed in rare instances only would

I think myself justified in adopting any of these methods in the case of patients under fourteen years of age. Had I treated the subject from that particular standpoint I believe I should have said just exactly what I did say with regard to one class, and about this with regard to the other class: In supplying missing teeth in the mouths of patients under fourteen years of age I would attach them in the most simple manner possible, and with the view only of supplying something to retain the space until a method may be utilized which will offer a more favorable degree of permanency and usefulness.

I regret that I did not present this subject to you as I can now see how it should have been presented; but, after all, I would proceed along the line of the methods indicated in the mouths of all patients where I felt that more or less permanent results were expected and desirable. In the mouths of patients under fourteen years of age, where such procedures would be impossible, I would make an effort to maintain the condition until such time as these procedures, or similar ones, would be indicated and applicable. I want to thank you very much for the courtesy you have extended to me.

The Conformation of the Face in Relation to the Development of the Eye.

By F. Park Lewis, M.D., Buffalo, N. Y.

The reluctance which I felt in accepting an invitation to read a paper before a body of men engaged in work of a character different from that which occupies my own efforts would have been a prohibition were it not for a common ground which we occupy.

For, while I not only cannot add to your interesting discussions concerning the value of certain molars on the subsequent development of the jaw, or of the methods employed in making less aggressive, prehensile teeth, I am constrained to confess to you that the subject of orthodontia, important and fascinating as it is, is known to me only by the seemingly marvellous metamorphoses which follow the application of your skill.

But although your technique and methodology are the result of careful specialization along lines distinctively your own, I have been impressed for some years by the conviction that the readjustment of the architectural foundations of the skull produce effects which are more than cosmetic, in giving character and dignity to an otherwise weak and vapid countenance; more than mechanical, in opposing surfaces that would not otherwise correctly impinge upon each other, for by altering relationships and thereby permitting functional activity where before the nervous or the lymphatic

or the blood supply was obstructed or impeded, you are making possible fundamental changes in nutrition, in development, in growth, that could not else have been obtained.

When the contour of the arch upon which the brain case rests is altered by an expansion of its base or by a change in its basal curve every buttress and flying buttress is modified by this variation as a direct consequence.

If the bony palate is high and pointed and narrow, and the teeth so crowded that some are erupted out of the normal line, the mechanical fact of spreading the jaw results of necessity in the lowering of the dome, if the change is made while the tissues are still plastic, and that change of form in the young extends in its bearings upon the maxillary antrum, the orbit and the sphenoid and through these upon the whole calvarium and that which it contains. I am sure, therefore, that there is a common ground

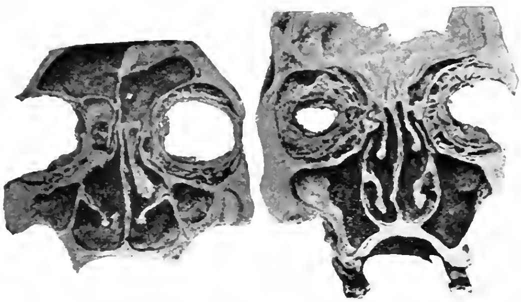

Fig. 1.

Sections through skull showing unequal depths of orbit, unequal antra, etc. (from Cryer).

upon which we can meet, and I do not believe that there is a subject of deeper interest nor one of greater importance than that which we are to consider because it has to do with the actual making of the man, and the determination of his physical and probably of his sensual intellectual and moral attributes. It will be my intention in this paper to demonstrate the thesis, that,

(*a*) normal and symmetrical development requires for its expression the proper performance of function; and

(*b*) that function is frequently impeded by mechanical obstacles, and

(c) that by the artificial removal of these impediments growth will follow.

Consider for one moment the far reaching importance of this statement, if it can be shown to be true.

The keystone of the skull is the sphenoid. If we modify the base

against which the corner stone rests we are altering a series of contingent relationships; we are modifying the nutritional supply as it is carried to one side or the other, permitting or interfering with, if we begin while the tissues are still plastic, symmetrical development of the two sides of the head, and changing the structural conditions of the mouth, the nose, the face, the orbit, and the eyes, and through these the brain functions and ultimately the brain itself, and therefrom every bodily function and tissue.

It is exceedingly interesting to note, as Cryer has shown in his valuable studies of many dissections of the face, the great variation which occurs in the two sides of the human head. (Fig. 1.) He finds that there is no typal head, that it is a rare exception to find correspondence in form in the right and left maxillae, in the position and shape of the septum, in the proportionate depth of the sides of the same face, and that these vari-

Fig. 2.
Left eye higher than right, with resultant pathological changes in left eye.

ations run through a wide range from those so slight as to pass unnoticed, to those so great that they are immediately evident to even the unobservant eye.

The first proposition which I wish to formulate is:

1. *That normal functional activity of organs designed to act coordinately is based upon their anatomical similarity.*

It is very evident that if one's legs are not of equal length one must limp.

If one's eyes are not of the same size, if the curves of one diameter of the cornea is not that of another, if one eye is more deeply set than the other, and more especially if one is higher than the other the same focal effort will not produce the same result. (Fig. 2.)

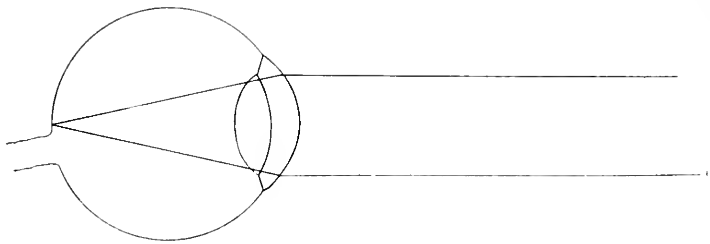

Fig. 3.

Focally normal eye. Parallel rays focused without muscular effort on retina.

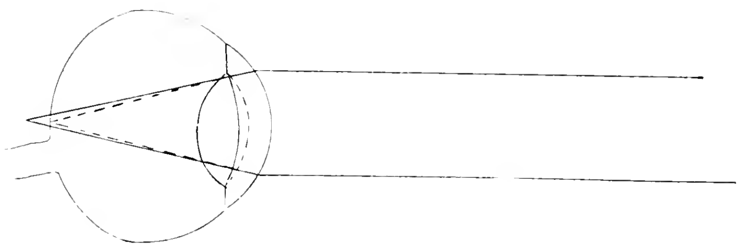

Fig. 4.

The hyperopic eye. Undue muscular effort required to focus light rays on retina.

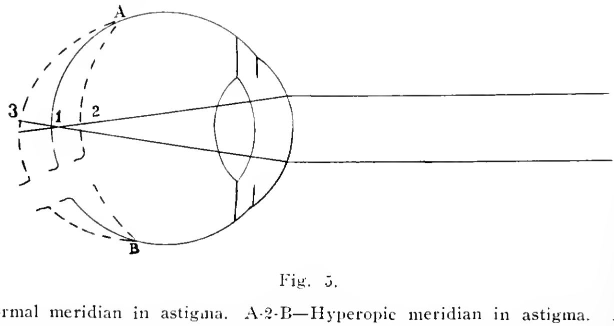

Fig. 5.

A-1-B—Normal meridian in astigma. A-2-B—Hyperopic meridian in astigma. A-3-B—Myopic meridian in astigma. Two of these conditions may exist in same eye, producing torsion strain.

Binocular Vision Explained.

If you will permit me I will sketch in briefest outline the manner in which the function of binocular vision is produced.

When the eyes and their muscles are anatomically alike in form and relationship, or so nearly so as to be considered practically alike, the associated actions are so coordinated that the images formed upon the retina excite sensations which are carried to corresponding parts of the cortex and blending, produce a single effect.

In order that parallel rays of light shall reach the retina, however, without focal effort on the part of the ciliary muscle, the length of the eye ball must bear such a relationship to the refractive system that these rays will be exactly focused on the macula.

Fig. 3 will make this clear.

If the eye is too short in its anterior posterior diameter the rays of light emanating from a point twenty feet or more away will not yet have come to a focus and unless extraordinary effort is made on the part of the ciliary muscle the impression is blurred and indistinct, but as the instinct is always to see, a strong muscular effort permits increased curvature of the lens, and a corresponding shortening of the focus. (Fig. 4.)

If, as not unfrequently happens, two diameters at right angles have different focal values (as I have attempted to show in Fig. 5) a torsion strain must be put on the ciliary muscle to produce lenticular curves that will neutralize those of the deformed eye ball.

Now if again, the eyes are not organically alike, the one being too short from before back while the other is of the normal form, or too long, or if the one is unequally developed in one way while its fellow is irregular in another the effort to synchronize their actions through the brain association of commisural fibres is a source of such profound central disturbance that not only the nutrition of the organs themselves suffer, producing all kinds of inflammatory and degenerative lesions in the eyes, but through reflex irritation directly carried to other nerve centers disturbs the functions of the digestive system, interfering with metabolism, affecting the circulatory organs, and most directly involving the activities of the cerebro-spinal system.

Should the differences in the eyes be so great that they cannot be made to work coordinately, one turns in or out, so that the visual lines are not brought to bear in a common point, the act of vision is carried on by one eye only, and the other no longer in commission gradually loses the ability to see, and a squint not corrected by the production of binocular vision in early childhood results in permanently dull sight, if not an absolutely blind eye.

As these facts are no longer subjects or argument but are generally accepted, I am warranted in my second conclusion that;

Anatomical Asymmetry.

II. *Organs especially intimately connected with nerve centers when not anatomically alike, as frequently occurs in the human eyes in attempted co-ordinate action, produce most profound disturbance of a nervous character.*

Like most of the other structures in the human body, the eye has neither attained its full size nor full functional activity at birth.

The infantile eye is generally shallow. Concerning this Landolt, whose observations have been most careful, remarks:

"The typical hyperopic eye may be considered as imperfectly developed. This arrest of development may vary from the normal human eye, to similarity with the eye of the higher mamalia, in the class and to microphthalmus in the species. It is indeed important to note that the eyes of the lower order of animals are nearly all hyperopic. Moreover, in the eyes of children under eight years of age hyperopia is the rule. They become emmetropic or normal only when later on the body has attained its full development. Finally this refractive condition is unusual in ill-formed eyes, those affected by any defect in evolution."

Further, he continues, "the conformation of the cranium and that of the eye is still more apparent in certain cases of asymmetry of the cranium and of the face. We very often meet people in whom one-half of the head is visibly smaller than the other. One side of the forehead is only partially developed, receding, the cheek bone more or less flattened, and the diameter of one cheek less than that of the other side.

The same difference is also found between the two halves of the palate. One side of the chin is, as it were, atrophied relatively to the other. The median line of the face is not straight but slightly curved and turning its convexity toward the better developed portion, as if the latter tended by its more active growth to surround the other, which has been arrested in its evolution. Frequently the measurement, or even single inspection of the cranium denotes a similar difference.

"In the majority of cases" he goes on, and in this he is supported by the general observation of ophthalmologists "we find corresponding to the less developed half of the head, the eye whose refraction is weaker (the smaller one) oftenest hyperopic or presenting a higher degree of hyperopia if this refractive anomoly exists in both eyes."

Now while the narrow, crowded face irregularly developed is common with inequalities of the eyes the usual form in which the hyperopic or shallow eye is found is the flat or shallow face.

This may or may not be accompanied by nasal obstruction. I think that it frequently is.

Defects, when they do exist, are usually post-pharyngeal, and of course, demand operative intervention.

The fact that the parental form with its accompanying defects may be an inheritance too, must not be forgotten.

The attempt of this paper is merely to show that there may exist forms of asymmetry dependent upon definite obstructions of nutritive channels, and which warrant early, intelligent recognition with a possibility of

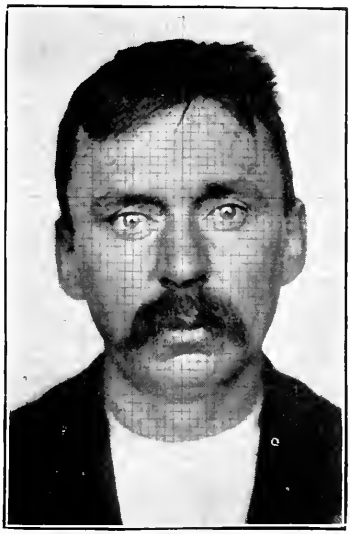

Fig. 6.

Screen method of measuring a human face.

their subsequent modification.

Hyperopia may be spontaneously rectified. The dimunition and disappearance of hyperopia, which takes place gradually in certain individuals during the period when the entire organism is growing and acquiring its definite form, may easily be followed by the aid of the ophthalmoscope. The eye participates in the general development, and from being imperfect as it has been, becomes normal."

The large results produced by small differences in axial length will be appreciated, when I say that a deficiency of 1 mm. will make a difference

of 3 diopters, a focus of 13 inches, while a lengthening of curvature of the radius of the cornea by 1 mm. produces a hyperopia of 6 diopters—6½ inches. (Fig. 6.)

I think that I am justified then in the third conclusion from these premises, viz.

Etiology of Asymmetrical Development.

III. *Asymmetry of the skull is so frequently associated with faulty or irregular development of the eyes, that it is safe to assume either that the shape of the eye is modified by the form of the face, or that both are determined by the same cause.*

Are there, then, the question naturally follows, known conditions which influence the form which the face, and therefore the orbit and the eye will ultimately assume?

We definitely know that there are.

As Cryer and other anatomists have shown, the cancellated structure of the bones of the head is filled with canals through which pass the nerves and vessels designed to supply local and distant tissues.

Now when these foramina are narrowed by pressure from adventitious growths or crowding from any cause whatever, the function of the nerves and nutritive channels is interfered with "causing abnormalities in the area of distribution," with resultant atrophy, neuralgia, or other trophic disturbance of the part involved.

Concerning this, Sajous has to say that it will be apparent that any lesion capable of blocking the multitude of afferent and efferent impulses that traverse it at all times and which represent the aggregate of the organisms, inciting and governing energy, must necessarily compromise life, or the functions of an organ to which the blocked nerves are distributed.

Now, as is well known to orthodontists, lymphoid hypertrophies in the pharynx and its vault are very commonly associated with malformation of the mouth and face.

It is not necessary here to enter into the question whether mouth breathing by the suction produced on the plastic palatal bones produces the high arched palate, the narrow jaw, and the crowded condition of the teeth, or whether, as I have discussed elsewhere, the narrowing of the skull bones interfering with the normal lymph flow is the basic element in facial asymmetries and other deformities.

Aside from all theories, it is an observation of almost daily frequency that mouth breathing is associated with facial irregularities, often of high grade, that these in many cases are accompanied by consequent squint, with ultimate amblyopia in the inturning eye.

Stammering when present shows an added lack of co-ordination in the nerve centers.

I have already in a paper, which I had the honor of reading before the "New York Stomatological Society in February, 1902," touching on the same subject directed attention to the remarkable experiments of Ziem, reported in the *Monatschrift fur Ohrenheilkunde*. Those of you who have followed his work will remember that after sewing up the nostril of young rabbits he found that on the side which had been made impervious to the air the eye remained in a permanently flat, or undeveloped condition, in other words, abnormally hypermetropic.

The restoration of patency in obstructed nostrils, especially when this

Fig. 7.

Base of skull, showing relation of foramen lacerum medium to the pituitary body (Cryer).

is accomplished by the removal of adenoids, is followed by beneficial results, that are so great as to be seemingly out of all proportion to the exciting causes.

The mental hebetude disappears and a most surprising intellectual development follows. These facts, I think, warrant the conclusion that

Effects of Nasal Obstruction.

IV. *Any persistent obstructions in the nose or naso-pharnyx interferes with the nutrition and subsequent development of the face and eyes, producing asymmetries of form.*

The limits of time allowed in a paper of this character, as well as the bounds of your courtesy and patience, demand that I race to my conclusions instead of systematically presenting the detailed data, which seem to

warrant final generalizations, but you will permit me to speak of the added importance which recent inquiry has given to the pituitary body in this connection.

I had already spoken of this relationship in my previous paper more than a year before the appearance of Sajous's work, on the "Internal Secretions and the Principles of Medicine."*

The pituitary body, it will be remembered, is a bi-lobed organ, resting in the *sella turcica.*

The conclusion concerning it, which Sajous reaches, is that

"The posterior pituitary body is the general center of the organism from which all of the nervous energy transmitted by the bulbar centers arise."

Now the anatomical relationships are such that immediately above the site occupied commonly by adenoid tissue is the *foramina lacerum medium* filled in a normal condition by fibro-cartelagenous tissue and opening into the carotid canal, which bears the carotid artery, the superior cervical sympathetic and the lymphatics.

The important bearing of the sympathetic will be seen, when we recall the fact that from the cavernous reflexes branches are given off to the mucous membrane of the sphenoidal sinus, to the dura mater of the baselar groove, the pituitary, the third, fourth and sixth nerves, and to the Gasserian ganglion of the fifth, and also send a branch to the ophthalmic ganglion. (Fig. 7.)

The large mortality under chloroform narcosis in adenectomy is in all probability due to the shock conveyed to the posterior pituitary body through the *foramina medium lacerum* immediately over the lyphatic enlargements.

It will readily be seen, therefore, that whatever interferes with the nutritive functions at the vault of the pharynx may disturb the subsequent development of the whole skull and of its contents.

I am now ready for my final conclusion, which is so far reaching in its consequences as to be both novel and somewhat startling, but I am inclined to think that you will agree with me in justifying the deduction from the preceding premises that:

It is not impossible that abnormalities of ocular form, with their disastrous consequences, may be avoided, and normal symmetrical development encouraged by mechanical interference with obstructed blood, nerve and lymph channels, whether in the naso-pharynx, nose or mouth.

Perhaps one of the most important discoveries made during recent years is that the blindness following disuse of a squinting, hyperopic eye,

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*Chas. de M. Sajous, 1903.

is not inevitable, but that visual training, if undertaken sufficiently early, that is during the first five or six years of life, will preserve the integrity of the nerve centers, that must else inevitably suffer.

I would not be misunderstood in predicting conclusions on the foregone statements involving broad generalizations.

In many asymmetrical faces are eyes which have a normal development; and conversely in many cases, though less frequently, eyes that are focally markedly unlike may be found in faces in which the difference in form of the sides is not apparent. For this there may be several reasons.

(a) The inequalities may be largely in the under jaw, as in the case to which I here invite your attention. (Patent exhibited.)

(b) Mere axial changes in teeth would not be likely to largely affect the development, although they would greatly modify the appearance and regularity of form.

(c) Definitely anterior alternations of form even in the superior maxillary bone might not influence the growth of the orbit, or eye.

(d) Orthodontia undertaken too late after the future form had been well indicated, would not, in all probability, largely modify developmental results as affecting the eye.

(e) Orthodontia undertaken while post-nasal or nasal obstructions were still present, thereby tending to allow reproduction of the same abnormalities of the vault of the mouth, which mechanical intervention was designed to correct, could not be expected to prevent asymmetrical growth.

But, having produced a normal condition of the air cavities of the head, and at the earliest possible day having corrected existing irregularities of the mouth, we are then in position to begin systematic training of an undeveloped eye.

The manner in which this may be done is of interest, especially to the ophthalmologist, so I will say merely that the intelligent direction of the growth of an immature eye at this stage would lie primarily in an accurate correction of all focal differences, so that the fusion function could be perfectly performed, and then by a gradual reduction of the strength of the spherical lens, as growth progressed development could be encouraged by the same physiological processes that we would employ to produce like results in any other organ or tissue, that is to say, regular systematic exercise, definitely planned and judiciously carried out, with *invariably volitional impulse*, and concentration of the mental energy on the visual act, which must be accompanied by binocular fusion.

The development of any structure, as Dr. Anderson, of Yale, has shown, premises the volitional direction of nervous energy to that part, but before this can be done the mechanical channels must be made free, and

whether this be done through the agency of the rhynologist, the ophthalmologist or the orthodontist the gateway is opened for developmental possibilities of such a far reaching character that their results may not even be guessed.

Discussion.

Dr. Edw. H. Angle, St. Louis, Mo. I hardly feel qualified to discuss this subject, but I confess that I feel proud that such a splendid paper should be read before this society. I am also pleased to have a new field of observation opened to me along our own line. We all know that malocclusion is often accompanied, if not produced, by diseases of the nose, but I doubt whether many of us have stopped to consider that it had any influence on the eye. I can now look back and recall a number of patients who also had trouble with their eyes, which it now seems to me possible may truly have been related to the malocclusion of the teeth. In the future I will consider these cases more carefully with reference to the effect on the eyes, so that I may be able to discuss this matter more intelligently than I can at this time. I am very grateful to the doctor for bringing this new subject before our society.

Dr. N. S. Hoff, Ann Arbor, Mich. We have all known, either from personal experience or from a perusal of the literature, of cases of eye, nose or other facial troubles which subsesequently were found to be caused by pathological conditions of the teeth. This is well established, for in most of our textbooks on pathology such cases are cited. But the subject as presented to-day, has taken a direction I never thought of before; its influence on the development of the face, and an organ so remote from the teeth as the eye. It is rather strange that we did not heretofore take into account the intimate relationship existing between all the structures and organs of the head. If the conditions of the nose and contiguous structures affect the eye in its development, why may not also the brain be affected? May not this be an important etiologic factor in the causation of nervous disorders? Such an assumption is perfectly logical.

Dr. M. C. Watson, Detroit, Mich. We have always been taught that it was not advisable to undertake such operations as we have to perform upon the jaws until the eleventh or twelfth year, but that is not true to-day. We are doing a great deal for children at six and seven years of age, and we are doing something for children younger than that. If I can be convinced of the wisdom of it, I believe it possible to do a great deal for children three or four years old.

Dr. Lewis. I have been greatly interested in the discussion upon the subject from the standpoint of the orthodontist. I would not be misunderstood in my statements. My conclusions are tentative and much careful observation will be required before they can be made absolute. The ground is new and one hesitates to venture upon it, but I have been watching for so long a time the relations between facial and ocular irregularities, that I cannot escape the conclusions to which these observations have led me. I am not endeavoring to prove a preconceived theory, but the theory naturally follows as a result of observed facts. I hope we may ultimately gather data which will enable us to arrive at definite conclusions as to the influence which the shape of the mouth and the condition of the teeth may have on the development of the head.

In order that our evidence may be classical and positive, it will be necessary to follow an undeveloped eye through the changes which take place under normal as well as under abnormal conditions. We have indeed seen changes take place in the eye of a growing child. We know that asymmetries of the eye are associated with disparities in form of the face. We must demonstrate, however, that given inequalities in the eyes are associated with given inequalities in the face, and that a more even facial development will be associated with greater harmony of form in the eyes. It is this line of work that will give us fundamental facts. I am merely breaking ground and outlining possibilities.

Can we then develop the face at will as we can the arms and legs? It would seem reasonable to believe that within limitations we can. But we must attack these conditions at a very early age if anything is to be accomplished. We must mold the form while the tissues are plastic. You, as orthodontists, are handicapped by the fact that until the sixth year molar erupts you have no anchorage for your morphology.

An important fact brought out in the last two years by Mr. Worth, of London, England, has changed our ideas with regard to the possibilities of developing the eye. The idea which we all held for many years was, that an eye which became blind because it had turned in, remained so. Mr. Worth began with the idea that by taking children when they were very young, the vision could be improved through development of the corresponding brain centers; children with facial disparities were given glasses, when they were required, at as early an age as two years. Then he devised an instrument called the amblyoscope, by means of which the child could fuse images and thus bring about co-ordination of the eyes and the brain centers. In a month or six weeks the eyes would straighten and then having developed fusion they would work co-ordinately. The brain cells would thus be enervated and energy carried from the cuneus to

the eye, and from the eye to the cortex back and forth, would re-establish binocular vision, a restoration of sight following. Having made the eye see, the next thing is to make it grow. The reason that it turned in was that it was not in the same form and shape as the other eye; hyperopic eyes are not equally developed, and one eye usually turns in.

That was a great step in advance; the next point is to watch that eye for years and note whether we are changing its form in any measurable degree. At the same time we must see to it that there is patency of the nose; that there are no adenoids; that a normal condition of naso-pharynx is present; this is essential to normal development. But as you cannot expect to change the shape of the mouth until the seventh year, when you can get anchorage, valuable time is lost. The time to do this work really is earlier than that, because, as Mr. Worth has pointed out, the damage is done to the eye before the sixth or seventh year. The object is to direct nerve energy properly during the plastic developmental period.

The Great First Class of Malocclusion.

By Dr. H. A. Pullen, Buffalo, N. Y.

The vast field included in the class indicated in the title of this paper precludes any attempt at doing it justice as a whole. Its proper consideration would fill a volume. I shall only attempt to repeat a chapter of my experience in the diagnosis and treatment of this class of cases, which is very likely similar to that of many others present, and which will only bear repetition because of your forbearance with an enthusiast, who is working towards an ideal, which can never be pointed out too often. The attainment of normal occlusion is like the solving of a difficult geometrical proposition, the interest increasing with the difficulties, and there is present a certain fascination which causes us to persevere and overcome obstacles until the desired result is obtained, or its impossibility assured.

Including, as it does, Class I., Angle's class, the largest percentage of cases that present, within its sphere of treatment may be found our greatest experience in the correction of malocclusion, and consequently, our greatest number of successes or failures.

The arches of teeth being normally related mesio-distally, it would seem that the diagnosis and prognosis of this class of cases would be easy, but if it were not for the fact of the dependence of diagnosis on occlusion, we would certainly be puzzled over some of the cases that present, for of all the three classes and their subdivisions, the first presents the most misleading characteristics, especially if the facial lines are taken as a guide rather than the occlusion.

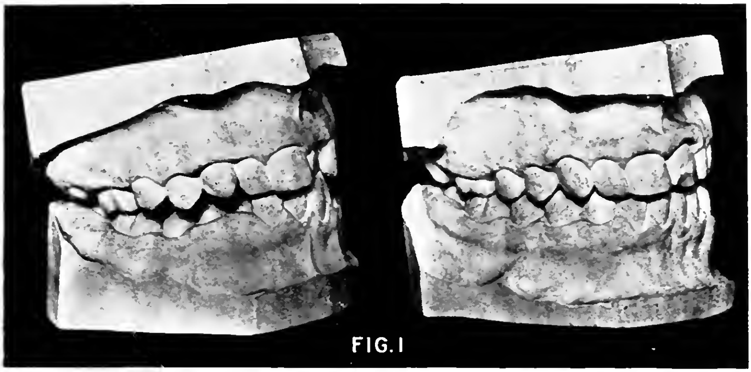


FIG. 1

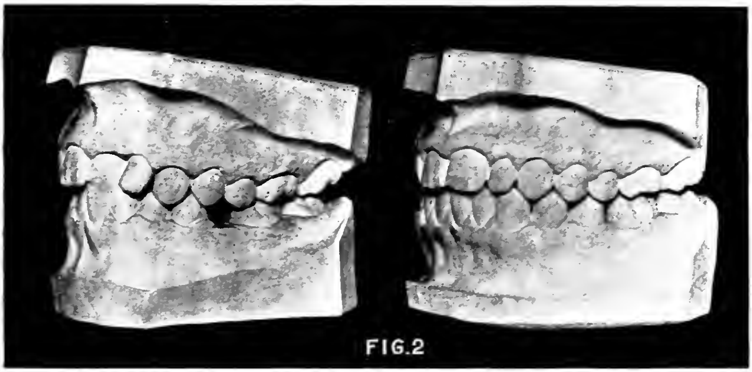


FIG. 2

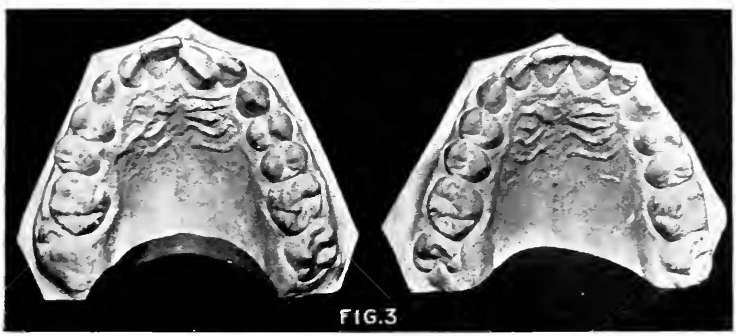


FIG. 3

The diagnosis of this class indicates the restoration of normal occlusion through expansion of arches and placing of the occlusal inclined planes of the cusps of the teeth of one arch in harmony with those of the other, excluding extraction as a beneficial procedure, except in rare cases. In cases where extraction has already been resorted to, the restoration of lost spaces should be accomplished, and retained by proper methods.

Case I.

Fig. I. represents the right occlusion, before and after treatment, of an average case of this class, the arches being contracted and the anterior teeth in various positions of malocclusion previous to treatment, and afterwards in normal occlusal relation.

The left occlusion, in Fig. II., illustrates the movement of the left central from lingual to normal occlusion, and the regaining of the proper space for, and restoration, or rather, eruption, to normal position of the lower second bicuspid on the left side.

Fig. III. exhibits the restoration of the normal shape and size of the upper arch, the teeth being placed in the line of occlusion, as noted in the cast on the right of this picture.

Fig. IV. presents the chief difficulties encountered in the case, and the attainment of the same ideal shape of the arch as a final result. The lower unerupted bicuspid very quickly took advantage of its release from imprisonment between the first bicuspid and molar, and erupted into occlusion without mechanical aid, and became a keystone to hold the arch intact.

Thus we have obtained a harmoniously aligned and occluded denture, and reached the ideal which we desired.

Case II.

The next models, shown in right and left occlusion in Fig. V., might, at first glance at the anterior teeth, be taken for a case belonging to Class II., the first division of which represents protruded upper incisors, and a distal occlusion of the lower arch, but when the occlusion in the molar region is noted, it will be seen that the case is clearly Class I., being normally related mesio-distally, and the protrusion of the incisors, and the appearance of the facial lines is not sufficient to diagnose or classify the case.

Proper treatment follows the same lines as the preceding case in the restoration of normal occlusal relations.

Case III.

Fig. VI. represents the right occlusion of a boy ten years of age, before and after treatment, and the temporary retention of the space for the unerupted cuspid. The crown on the upper first molar is not the work of a Buffalo artist. I am very positive that there was no necessity for its mutilation in this way.

FIG. 4

FIG. 5

FIG. 6

FIG. 7

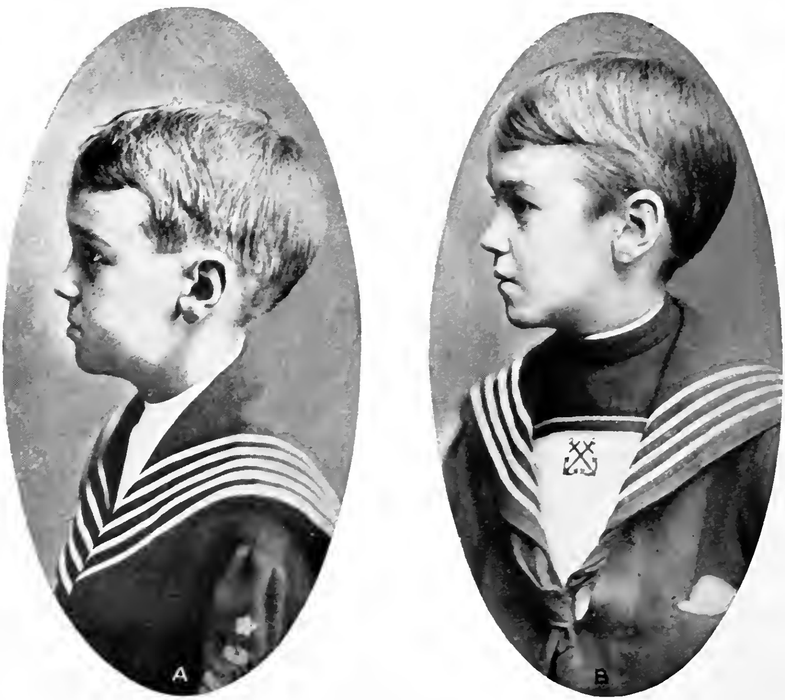


FIG. 8.

The left occlusion of the case in Fig. VII. exhibits a more artistic appearance and shows the relationship, before and after treatment, of the left side in occlusion. In this case, also, if one were to judge by the appearance of the anterior teeth, it might be thought to belong to Class III., in which the lower arch is mesial to normal, for the same characteristics are present anteriorly.

The facial lines in Fig. VIII. A, tell the same story, and unless the occlusion in the molar region were noted, a mistake would not have been unlikely in the diagnosis and treatment. The improvement in the facial lines after treatment is very marked, the upper lip being brought out to its proper position and contour. (Fig. VIII. B.)

Case IV. Restoration of normal occlusion is not always possible in every case of this class, even when the diagnosis seems to indicate it, as illustrated in Fig IX., which shows the right occlusion of a case in which I found it impossible to find space for, or to place in its normal position, the right upper lateral incisor. The case looks easier than either of the two previous ones illustrated, in which normal occlusion was restored, but looks are sometimes deceiving. The central and cuspid in the completed case are shown adjacent to each other, and the lateral had to be extracted, because of its abnormal shape and position, as will be shown a little later.

Fig. X. shows the left occlusion of the same case before and after treatment, but no feature of any importance.

Fig. XI., the occlusal view of the upper casts, before and after treatment, pictures the condition of affairs, and the malformed lateral is seen on a bit of wax on the left cast. An attempt was made to align all of the anterior teeth except the lateral first, and then it was found that there was not room for it, and the abnormality was only discovered on its extraction. If I had been able to make space for this lateral, I would never have been able to place it in position in the arch.

The peculiar bayonet shape of the root rendered its extraction very difficult.

Case V. The most interesting case (Fig. XII.) I have reserved until the last, because it presents certain difficulties of treatment which seemed almost impossible of overcoming without a faith in the possibilities of occlusion strong enough to be equal to any emergency, or remove any obstacle in the way of accomplishment of the restoration of normal occlusion, after having once decided that it was within the range of possibility. The diagnosis of the case may be made from this picture, and the next, which show the right and left occlusion of the case before and after treatment. The case is that of a boy fourteen years of age, and in the model of the right occlusion (Fig.

FIG 9

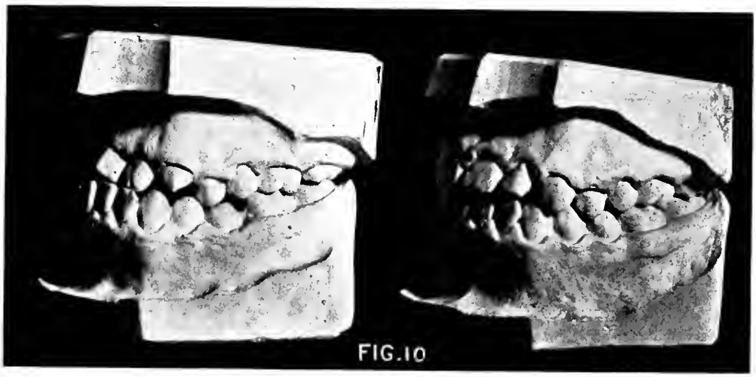


FIG. 10

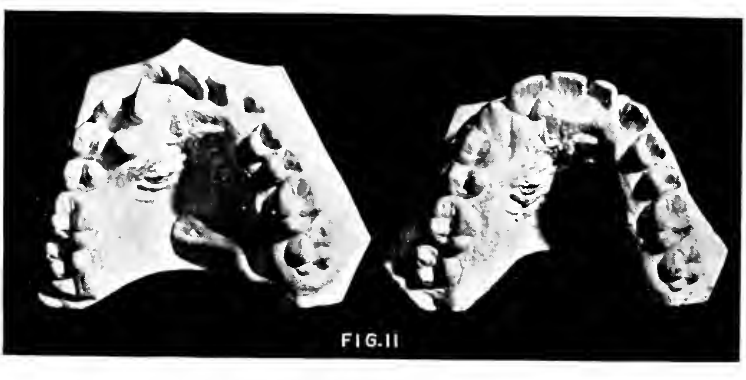


FIG. 11

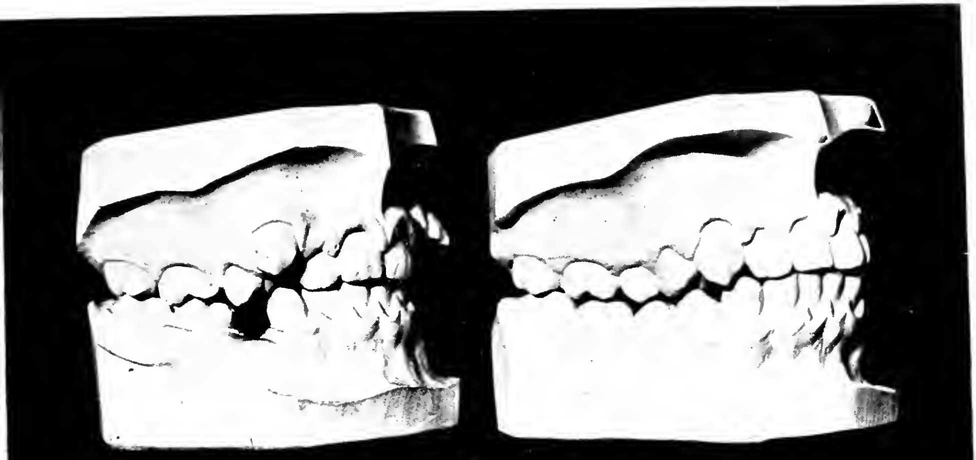


FIG. 12

FIG. 13

FIG. 14

FIG. 15

XII., left model) may be noted the contraction of the arch, the closing up of the space for the upper second bicuspid, and the partial closure of the space for the lower bicuspids, which have bunched up outside of the arch, as appears.

The model on the left of Fig. XIII. shows the contraction of the arch and the complete closure of the space for the upper cuspid and the lower second bicuspid.

Fig. XII. illustrates the right occlusion, before and after treatment, and the restoration of normal occlusion.

Fig. XIII. shows the left occlusion, before and after treatment, and I think it is the best result I ever hope to obtain. The facial lines are normal, there being no protrusion after treatment, as might have been expected in such a case.

Fig. XIV. shows the occlusal view of the upper, before and after treatment; in the cast on the left may be noticed the complete closure of the space for the left cuspid and almost complete closure of the space for the right cuspid, also the closure of the space for the right second bicuspid, which lies embedded in the process lingually. This view also shows the extraordinary enlargement of the arch for the accommodation of these teeth in the cast on the right.

Fig. XV. shows the peculiar conditions existing in the lower arch (see cast on the left). The two bicuspids on the right side are bunched up buccally, with only half the necessary space for them in the arch. On the left side, the space for the second bicuspid is completely closed. The cast on the right illustrates the response to treatment.

An interesting feature of the case was the eruption of the unerupted teeth almost immediately after space was obtained for them in the arch, and only the slightest traction was needed to bring them into position, Nature doing her part grandly when the opportunity was given.

Last, but not least, the retention was the simplest of any case I have ever undertaken of like difficulty. After wearing spur retainers on the cuspids for about three months, all retainers were removed and occlusion was depended on entirely for the permanent retention, and it presents the same appearance today as when completed.

Discussion.

Dr. Edward H. Angle I wish to express my very great appreciation and admiration of the work Dr. Pullen has shown us in the treatment of this great first class of malocclusion, because it shows me what are among the easy possibilities for a man who will specialize, provided he has the requisite aptitude

and love for this work, coupled with the necessary artistic instinct.

Then again, I am greatly pleased, because his work confirms my own theory and firm belief that the old plan of extraction in these cases was as unnecessary, as wrong, and that the best results are only attainable by not extracting. But on this point, I think most of us here are now well agreed, so we do not need to argue it further; but to discuss it with the practitioners of general dentistry is much like attempting to talk the waves of the ocean into silence. They have so long been imbued with such bad teaching, and the principle is so strongly intrenched in their understanding of the requirements of orthodontia that nothing, I fear, will persuade them differently, and if we cannot impress teachers in our dental institutions with the folly of their pernicious doctrines, how can we expect much of the product of their teaching?

Dr. Ottolengui. Dr. Pullen is to be congratulated. I carefully studied the models of his last case, some months ago, and I consider it a triumph of the art of occlusal restoration. I doubt if there is a case recorded in our literature that parallels the skill of the achievement.

Dr. Lloyd S. Lourie, Chicago. I would like to have a point explained. Where the lateral was extracted there was no explanation made as to how this was to be compensated for, either in the upper or lower arch.

Dr. Pullen. In answer to Dr. Lourie's query concerning the compensation in occlusal relations in the case in which the upper right lateral was extracted, I would say that the occlusion in the anterior part of the two arches was harmonized by the slight contraction of the lower arch, due to the torsion of the lower right central incisor, together with a slight spacing between the upper incisors.

I certainly feel highly complimented by the remarks of Dr. Ottolengui concerning this last case shown, and I feel a stimulus towards renewed efforts in attempting apparently impossible cases which present.

Influence of the Premolar on the Profile.

By C. L. Goddard, A. M., D.D.S., San Francisco, Cal.

The Ideal Profile. The treatment of irregularities from the standpoint of the occlusion has caused us to pay more attention to the profile than heretofore, and to study means by which the profile may be improved and brought nearer to the standard.

The profile of Apollo has been our model, but the cut most often used from Bell's Anatomy of Expression, is faulty. (See Fig. 1.)

Dr. Angle's "line of harmony" described as a straight line touching "the most prominent points of the frontal and mental eminences and" passing through "the middle of the ala of the nose" is correct, but the drawing is wrong. The nose is not prominent enough. The line nearly bisects the nose itself instead of the ala.

Fig. 1.
Bell's Apollo.

FIG. 2

Apollo Belvidere (photograph from cast)

In order to test the correctness of this drawing and to study this profile. I went to the Hopkins Institute of Art of the University of California and carefully took a photograph of a cast of the original statue of Apollo which stands in the Belvidere of the Vatican, and which is known as the Apollo Belvidere. You will see (Fig. 2) that a straight line touching the most prominent portions of the forehead and chin does actually bisect the ala, or, in other words, cuts off two-thirds of the nose. The line also passes through the extreme edge of the lower lip, while considerable of the profile of the upper lip lies outside.

We find that the nose is actually a much more prominent feature than the first drawing led us to suppose, and that an actual profile agreeing with the first lines, is too flat. Either the chin is too prominent or the nose is not prominent enough.

Although we cannot expect to attain this perfect profile in all our work, it gives us a standard toward which we may strive. Every step toward that standard is a step away from deformity and ugliness.

The nose, chin and forehead may be in the true line of harmony and yet the profile may be distorted from a malposition of the lips alone. Both may be too prominent or too retreating, or either one may be out of line in regard to the other. An undue prominence may be due to actual thick-

Fig. 3.—Double Protrusion.

ness of the lips themselves, or may be due wholly to the prominence of the anterior teeth, both upper and lower. Both arches of the teeth may be normal and the occlusion may be normal. There may be no irregularity and no malocclusion, yet there may be a deformity which stands wholly outside of Dr. Angle's most excellent classification.

Double Protrusion.

If the prominence were wholly of the upper teeth we would call it a case of upper protrusion. If it were wholly of the lower teeth we would call it lower protrusion. There is a prominence of both upper and lower teeth, and I have called it "double protrusion." Such a case is illustrated in Fig. 3.

Both jaws are normal and the nose is normal, but the arches are too large. *The teeth* are too large for the maxillae, or, as comparative anatomists call them, the maxilla and the mandible. What may have been the cause of this, none of us know.

We were taught, years ago, that "a child may inherit large teeth from one parent and small jaws from the other." Recently the possibility of that has been denied, but who knows? A child may inherit his shape from

one parent and the color of his skin and hair from the other. Large teeth and small jaws have been considered one of the frequent causes of irregularity.

Irregularities.

In parenthesis let me say that I am not yet ready to give up the old term, "irregularities" for "malocclusion." If eruption is normal and there is no irregularity, there will be no malocclusion. If there is maleruption there will probably be irregularity of the teeth *producing* malocclusion. Malocclusion is the result, not the cause, of irregularity. If the irregularity is properly corrected, normal occlusion will be established.

New World Monkey. Old World Monkey.

The term "irregularity" has been used so long that it is thoroughly understood by our patients. This is the defect that they notice and desire corrected. The fact that it results in malocclusion must be explained to them carefully as well as the fact that the treatment of irregularity must be such as to produce normal occlusion as nearly as possible.

Comparative Anatomy.

Let us see what comparative anatomy teaches us about the profile. The normal dental formula is I $\frac{3}{3}$ C $\frac{1}{1}$ P $\frac{4}{4}$ M $\frac{3}{3}$. The six incisors in each jaw provide a full anterior dental arch. The four premolars and three molars on each side provide long sides to the arch. In most animals these sides are nearly parallel. Only two living animals are known to have the normal dental formula, the hog and the mole. In some animals there is an absence of the incisors (the edentata), in some an absence of canines (the herbivora), in others some or all

of the premolars are wanting (the rodents), and in others still some of the molars are missing (the carnivora).

In most animals that are deficient in canines or premolars, or both, there is a large diastema between the incisors and the molars, owing to the length of the jaws. In the same family there may be a crowding of premolars or there may be spaces between them, according to the length of the jaws, as in short-jawed and long-jawed dogs.

For our comparison we must take the animals most nearly resembling man, the quadrumana. If we select from the old-world and the new-world monkeys, two that most nearly resemble each other in size, we will find quite a variation in the facial angle (Fig. 4).

The incisors of the new-world monkey are more prominent than those of the old-world monkey, but why? Count the premolars. The one has three premolars and the other but two. By reducing the number of pre-

FIG. 5

molars from three to two the profile is straightened and the prominence of the incisors is reduced.

Do not misunderstand me as saying that this is done directly, in evolution from a monkey with three premolars to one with two. Nature does not work in so direct a manner, but in two long lines of descent from an ancestor with four premolars, the one that has lost the greater number has the straightest profile.

What does this teach us? It teaches us that, in a case where prominence of the lips is due to prominence of the incisors, and a deformity is the result, we may reduce this prominence by removing one of the premolars from each side of each jaw, then moving back the anterior teeth.

If the removal of this one tooth gives too much room the posterior teeth may be moved forward by a reciprocal appliance.

This treatment is well shown by a case of double protrusion first illustrated by the author in the American Text Book of Operative Dentistry (second edition, 1900, pp. 783, 784). (See Fig. 3.)

The relation of forehead, nose and chin was not bad, but the apparent thickness of the lips was due to the prominence of the anterior teeth as shown by the plaster casts in Fig. 5 A.

Both arches were normal in shape. There was no irregularity nor malocclusion—only deformity. The face and jaws were small, the teeth were too large for the other features. The four first premolars were extracted and the anterior teeth moved back, as shown in Fig. 5 B, so that their labial surfaces had a more vertical position. The posterior teeth at the same time moved forward slightly, without tipping.

Fig. 6, A and B, show how much the arch was shortened.

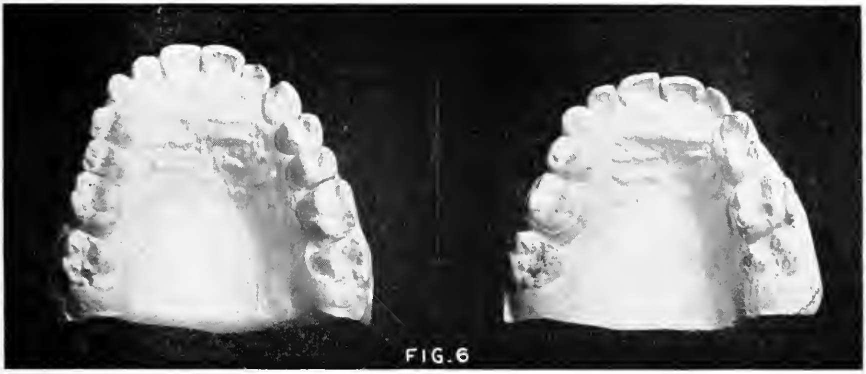


FIG. 6

Fig. 7, A and B, shows the result. The prominence of the lips was reduced and the general contour very much improved.

It is to be regretted that these two photographs were not taken in full profile so as to show more exactly the change produced but it must be apparent to you all.

The reduction was accomplished by means of two bows, the ends of which entered tubes on molar bands and were tightened by nuts behind the tubes, Fig. 8. In addition an occipital appliance was used with a bit that rested on the upper and lower anterior teeth. It was worn at night and part of the daytime. This is the only case I know of in which the occipital appliance has been made to operate on both upper and lower teeth at the same time.

At the last meeting of the American Society of Orthodontists Dr. Ottolengui showed the same kind of a case, except that it was complicated with irregularity of some of the single anterior teeth. He mentioned also other similar cases, all treated with the same beneficial result.

These cases teach us that extraction is *sometimes* advisable, in spite of modern teaching to the contrary.

You are all familiar with the text book cut that shows the position of the crowns of the permanent teeth before eruption and while the temporary teeth are in position. The late Professor J. H. McQuillen said: "When we are examining a series of jaws of different ages, arranged so as to show the deciduous and permanent teeth, it is not a surprising matter that there should be irregularity in the permanent set; but when observing their crowded and irregular arrangement in the jaw prior to eruption, it is rather a matter of astonishment that they should ever assume a regular and symmetrical appearance."

If then it is a wonder that teeth of normal size in normal jaws erupt in a regular arch, how much less does it cease to be a wonder that large teeth in a small jaw fail to erupt in proper alignment. It is a wonder, in the case I have reported, that the teeth erupted in such a regular manner and with normal occlusion.

These cases teach us that if we correct irregularities, in all cases, so as to produce arches of normal shape, we shall, in some cases, where teeth are too large, produce arches that are too large for the jaws and that will result in the very deformity we are discussing—double protrusion.

In such cases four premolars might better be removed before the deformity is produced and while there exists only irregularity and consequent malocclusion. After these four teeth are removed the rest can be more readily moved into alignment and normal occlusion of the remaining teeth produced.

Another thing that limits the extent to which the arch may be enlarged and spread to advantage is the narrowness of the upper maxilla in some cases in which the teeth are of normal size.

If we could move the roots of molars and premolars buccally as we can of incisors labially (Dr. C. S. Case's method) we might enlarge the arch to any extent, but as the crowns move outward the apices of the roots remain stationary or even move lingually. The result, in an arch spread too much, is that the crowns of the premolars and molars slant outward too much and the buccal cusps are too short to occlude with the lower.

In spreading both upper and lower arches, in cases where both are much too narrow, yet where occlusion of the premolars and molars is normal, and the irregularity is confined to the anterior teeth, the operation may be carried so far as to produce malocclusion. In such cases it is better to sacrifice the first premolars and thus produce a well formed arch corresponding to the maxillae.

Migration of Molars.

Many of you have noticed the tendency of molars to move forward when space is created in front of them by loss of premolars. The author has seen three cases in which the first molar was in contact with the canine and yet was not tipped forward. This tendency is so great that the interlocking of the cusps will not always prevent it, and often proves a great obstacle to our using the molars for anchorage.

If, in a given case, an operator should hesitate about producing too large an arch by moving all the teeth into proper alignment and should think he was almost warranted in reducing the size of the arches by sacrificing the four first premolars, yet should be deterred by fear of leaving space between the canines and the second premolars, or of moving the anterior teeth too far back, he may remember the tendency of molars to move forward and know that this space will probably be filled by that means. If it is not so filled he may readily force the molars forward by means of appliances.

Discussion.

Dr. Edward H. Angle, St. Louis.

I do not want to criticise Dr. Goddard too severely because he is a fine man, and I am proud to call him my friend. I think he is honest in making his deductions, but they are so radically different from what I learn from the case he reports that I think he has made a mistake, and I want to point it out.

The point he would make is that in this case extraction was necessary to obtain the best results for occlusion and for the facial lines. And he attempts to prove it. He selects a case that he calls one of typical double protrusion, but he does not say how rare they are. I have seen but one such case. He has selected a very rare case to overturn a theory of mine which I believe has practically an almost universal application; that is, that the full complement of teeth is essential to the best harmony in occlusion and in the facial lines, and I am going to try to prove to you with his own pictures that he would have had better results had he not extracted, but worked in accordance with this theory.

He says the occlusion in Fig. 5 is normal. The models are so poor that they are not at all reliable as a basis for very accurate judgment. I think they were made from wax impressions, and you all know that accuracy from such impressions is impossible. Then again, we ought to be able to examine the arches from the occlusal aspect. If we could do that I am sure we would find them narrowed, and as the result and in the same proportion we would find the incisors protruding.

Now in the treatment, if he had widened the arches laterally and moved the incisors lingually he would, in my opinion, have had better occlusion and more pleasing and harmonious facial art results.

Fig. 6 shows where the doctor has sacrificed four priceless jewels. It is unnecessary for me to enumerate the effects of this to you gentlemen who are familiar with such results, such as changing the normal curve of occlusion, narrowing, as well as shortening the dental arches, thus encroaching upon the normal space and necessary demands of the tongue, together with the different relations, which are here keenly apparent, in the delicate inclined planes of the cusps, etc.

The doctor says that he moved all the incisors and cuspids distally by means of the expansion arch with the nuts placed distally to the tubes on the bands on the anchor teeth, or first molars.* Now I want to tell you

*Dr. Angle overlooks Dr. Goddard's statement that he used an occipital appliance, exerting pressure on both jaws.—Editor.

that no man living ever accomplished what Dr. Goddard thinks he has in this case by such means. I have long been teaching that it was bad practice to subject the molars to such an excessive strain, for they cannot resist it and are invariably drawn forward more than the incisors and cuspids are moved distally, and this result is clearly shown in this case, and I will tell you how it can be easily proven. I discovered the means of determining it in a similar blunder made by Dr. Kells some years ago. It is by noticing the positions of the teeth with relation to the rugae, before and after they have been moved. Now if you will study the rugae in this case you will see clearly that the molars have been moved farther forward than the anterior teeth are supposed to have moved back. How long will men teach such errors?

Now in regard to the art relations of this case; if you will examine the picture of the face before treatment you will observe that it is one of a distinct type, similar to that of George Eliot and Savonarola. We now know that each face is a law unto itself. I once thought we could have a profile line applicable to all cases. I now know that was wrong and narrow. The demands of art will not be restricted. Now we know that we must study types, and that each type differs from all other types, and that the one principle required in each is harmony and balance; that is, the contour of the face both in its profile and laterally must balance. The nose, the chin, the length of the lips, all must be in balance if we would have the most pleasing result. The rules of the straight face cannot apply here because all the lines of the contour are on a curve. To make this face conform to a straight line in the region of the mouth would be to injure it. The curve of the face must be maintained, and all that was necessary in treatment was to soften the prominence of the lips by placing the teeth in harmony with their lines of occlusion, as I have before stated. You will note in the picture after treatment that there is an unnatural appearance about the mouth. The angle of the nose and mouth is not in harmony with the other angles of the face, as it would have been had the case been treated as I suggest. I may be wrong, but all of this is as it seems to me, greatly as I dislike to differ with my friend.

Now, in regard to Dr. Goddard's criticism of the Apollo Belvidere found in my book, I think he is right. There is a difference between that picture and the one he shows, as well as some others I have seen. I cannot account for this difference. Mine was taken from that celebrated work "Bell's Anatomy of Facial Expression" which has long been regarded as the masterpiece of its kind, and I therefore supposed that the picture of the Apollo, coming as it did from this book, was right. Which is right I cannot positively tell. Anyway Dr. Goddard's picture is to my mind the

more pleasing and harmonious in its balance. But, as I have said, we must not depend upon this line except in a limited number of cases. We must be judges of balance and harmony and be able to apply this judgment intelligently instead of depending upon fixed lines.

Dr. M. C. Watson, Detroit, Mich.

With the first part of Dr. Angle's discussion I agree most heartily. My sense of harmony, or balance, is jarred when I look at the second picture, the one taken after the case was corrected. In my judgment the misfortune in this case is that Dr. Goddard succeeded in doing what he tried to do. That he moved the molars forward, I have no doubt; but he also succeeded in moving the anterior teeth back, and that is what has ruined the face. I think the face was much better before treatment than it is now. That it could have been improved goes without saying, but the greatest possible improvement would have been made if the jaws had been widened so as to be in harmony with the facial type of this individual.

I cannot agree with the last part of Dr. Angle's argument, where he speaks of the rugae in relation to the teeth. When we move a lot of teeth *en masse* we do not move them through the process alone, but we carry it along with them, to a degree, at least, which is also true of the gum tissue.

Dr. Ottolengui, New York City.

I am very glad that this paper has come up with this case, and I speak on this subject because Dr. Goddard alluded to the fact that I reported a similar case; also because Dr. Angle said that these cases are rare. I have had three such cases, making a total of twelve teeth extracted from three mouths, and I fear that, in a way, I have dishonored myself by creating the impression that I am a tooth extractor. I have been told by a number of gentlemen, who are friendly disposed to me, that I "have no standing on the matter of occlusion." I am sorry to find that to be the case.

Dr. Angle said that he had seen but one of these cases. Judging from what he said about its correction, I should say that he has not met even the one case. I imagine that his case was similar to one I had where there was normal occlusion mesio-distally; narrowing of the arches, and protrusion of both jaws anteriorly, with separation of the teeth. That case was corrected without the extraction of any of the teeth. In retruding the incisal regions, after widening the jaws I used an occipital appliance without any inside apparatus. That child was very young, which was fortunate. The widening of the upper arch and the

relation of the occlusal cusps (the depth of the overbite) was sufficient so that widening the upper jaw also carried out the lower and thus subsequently the lower was widened sufficiently. I used an occipital appliance carrying an inclined plane to engage the lower teeth. There was no strain on the back teeth, and no possibility of dragging the back teeth forward because there was nothing attached to them.

The case I reported last year, I still consider was treated correctly. The child is still under my care. Six years have elapsed since correction, and the face is in perfect harmony. In the other two cases, which are still in progress, I believe I was correct in one case in removing the teeth. But in the second I am in a dilemma because the anterior teeth have curved roots, and I cannot carry the teeth back very much farther without causing an inward tipping of the anterior teeth.

I do not consider that the case illustrated by Fig. 7 required the extraction of four teeth. The first photograph is shown by Dr. Goddard to prove that the case required regulation; but I want to direct your eye to the tips of the nose and the chin and ask you if even with a pouting lip you would not imagine that the lower jaw is in distal occlusion. Has he not accentuated the receding line of the chin and made the face more angular, and the chin more retrusive than it was before?

I agree with Dr. Angle that every face must be a law unto itself, and that you must have in mind the beauty of that particular face and realize the unchangeable fixed points before you make any alteration. If you will look at the models again you will see that they are asymmetrical. They could have endured widening to a sufficient extent to reduce the frontal prominence which, really, required very little reduction, provided the chin was left unchanged.

Dr. Richard Summa, St. Louis, Mo.

Dr. Goddard says that both arches are normal in shape; there is no irregularity, no malocclusion; there is a deformity. Do all the gentlemen agree that the model made before correction of the teeth shows a normal occlusion of the anterior teeth? These teeth protrude and are therefore out of the normal line of occlusion.

I want to call attention chiefly to the malocclusion that existed, in spite of the author's statement to the effect that there was no malocclusion, no irregularity, only deformity. Malposition of the teeth is a form of irregularity, and whenever a tooth is in malposition it must be in malocclusion. I cannot conceive of a tooth being in malposition without being in malocclusion. The doctor is mistaken. There is malocclusion because there is malposition of the anterior teeth.

Dr. Ottolengui. What Dr. Summa says is not what Dr. Goddard means. I think he understands that the Angle classification is based upon the mesio-distal relations of the molars, and that in this case is normal. Of course, the anterior teeth are all in malocclusion. Dr. Watson takes exception to Dr. Angle's declaration that by the rugae we can determine the distance and direction of the movement of teeth. Dr. Watson says that the process and gum tissue to some extent at least move with the teeth.

I have done a lot of occipital work. For a number of years I operated extensively on protruding cases with skull cap and the mouth bit, and it was a constant and invariable experience that in the movement of the teeth backward the gum remained exactly where it was; the teeth slipped under it and the soft tissue peeled away from the bony tissue below, so that it was necessary from time to time to trim it off with scissors. That indicated that the work was progressing too rapidly. That was when I had an assistant who was in such a hurry to get through with the work that she put on too much strain. Consequently now in all my occipital work, instead of using bands cut from rubber tubing, and putting on strong bands, I supply my little patient with a box of the smallest commercial bands I can get. The child is sent away at first with just enough of the bands on to hold the appliance in place, and by adding more rubbers the strain is increased; the child can reduce the strain by taking off some of the rubbers. Since I have done this I have not had to excise any of gum tissue.

But this shows that the gum tissue does not move, but that the bony tissue in the path of the movement is resorbed. Dr. Angle is perfectly right in saying that we can use the rugae for comparison to tell whether or not the teeth have been moved. Take a point in the center of the vault, and this being unchanged by tooth movement will prove a reliable point from which to make measurements.

The Relation Between Orthodontia and Prosthodontia.

By Frederick A. Peeso, Philadelphia, Pa.

Every one who has made a careful study of these subjects must be thoroughly convinced of the intimate relation which exists between orthodontia and prosthodontia. Not every one, however, has made such a study of the problems which these important departments of our art present, hence it very frequently happens that the specialist in either department keeps his mind so intently fixed upon the details comprised in his own field of work that he loses sight of the important relations which all departments of dentistry bear to each other. The closeness of this relationship cannot be better exemplified than by a comparison between orthodontia and prosthodontia, the objective purpose of each being precisely the same, notwithstanding the fact that the end in each case is sought to be obtained by widely different means.

Orthodontia, as shown by Angle, is the science of normal occlusion. The problems which it presents for solution to the practical dentist are the problems of the restoration of normal occlusion. Precisely the same problems are those which are presented to the prosthodontist for solution, albeit, his work is complicated by the factor of restoration of lost structure in addition to the problem of occlusion.

It often happens that the services of the specialist in one of these branches will be of no real benefit to the patient without the assistance of the other. In very many cases where bridgework is indicated, it would be of little or no value unless the teeth were first brought into their proper position in the arch. On the other hand, where the services of the orthodontist have been employed, the benefit would be but temporary without some permanent appliance to retain the teeth in position and restore the lost organs of mastication. By being permanent, it is not meant that the appliance must of necessity be so fixed that it cannot be removed from the mouth, but that it can be retained in the mouth for a long period of years, holding the parts firmly in their natural position in the arch and at the same time enabling them to perform their normal masticatory functions.

There are various appliances which may be used for this purpose, but the question is, which will do the work best and which approaches most nearly to Nature in making this restoration. Of course the same appliance would not answer in every case. In some instances a partial plate might be indicated, but in the opinion of the writer, in the great majority

of cases a well made and perfectly articulated piece of bridgework constitutes the best of artificial substitutes for the lost organs and will perform the varied functions required of it better than any other appliance which is as yet known to the dental profession.

In many of the cases presented for treatment, the teeth have been lost at an early age and in restoring them, it is well to consider the relative permanency of bridge restorations. The life of a bridge depends primarily entirely upon the proper preparation of the abutments and the accurate fitting of the bands. These must be so prepared and fitted that there will be no irritation around the neck of the tooth from the bands cutting into the soft tissues. If the conditions are favorable and the work is properly done, there is no reason why it should not last practically for a lifetime. It is certain that after being in the mouth for fifteen years it will seemingly be in exactly as good condition as when first put in place and the chances are that it will be the same fifteen years hence. If the teeth are not properly prepared and the bands are ill fitting, the bands together with the cement will irritate the tissue to such an extent as to result in the loss of the tooth in a few years.

In order to be effective and get the best possible results, each case must be studied separately and carefully in every detail. The question of abutments must be considered, as to their relative strength, position and condition. The articulation, too, is of the greatest importance and cannot receive too careful attention, as the additional work which is put upon the roots which are to serve as abutments will not strain them nearly as much if there is a perfect articulation. On the other hand, let the preparation of the teeth and the prosthetic work be never so well done, if the piece be badly articulated, abnormal conditions are created which will not only impair the usefulness of the denture, but may within a comparatively short time not only entirely destroy the supports and injure the adjoining teeth, but may bring about very serious pathological conditions.

Fixed Versus Removable Bridgework.

If it be decided that bridgework is best adapted to meet the requirements of a given case, it is well perhaps to discuss at this point the relative value of fixed and removable work. It is unquestionable that if a removable appliance can be constructed which, when in position, is held rigidly in place, will resist wear and can be readily detached, it would be preferable to one which was permanently fixed. Such attachments can be made, which after years of use will show practically no wear at all and will be held as tightly in place as when first put in the mouth. This, too, where the piece is removed at least once every day and often many more times; but in making attachments of this kind, there must be the greatest accuracy or the piece will be worthless. There

is hardly a case where fixed bridgework is used, that removable would not answer as well, or be very much better than fixed.

Of the many advantages which removable bridgework possess over fixed work, the first to be named is its hygienic properties. No one can deny that a bridge which can be removed from the mouth, cleansed and sterilized in boiling water, if desirable, is far more cleanly and far less liable to become foul than is one which is permanently fixed and can only be cleansed in the mouth. In many cases where fixed bridges are worn, the mouth becomes so foul and the breath so offensive as to be almost unbearable, even when the best of care is given them. Another point in favor of removable work is the facility with which it can be repaired in case of accident and also the ease with which the adjoining teeth can be reached in case of decay or accident.

Any one who has undertaken to insert a gold filling in the approximal surface of a tooth adjoining the abutment of a fixed bridge, can appreciate the difficulties of such an operation. It is necessary to get a much greater separation than where no bridge is worn, as the rubber dam cannot be put on over a fixed piece. If the bridge be removable, it has simply to be lifted off, the rubber dam adjusted and there will be ample room to prepare the cavity and insert the filling without further separation, or if the anchorage be such that there will be no separation on the removal of the piece, the separation can be easily made after the bridge is off and the dam will include the abutment. Another advantage is that in case of any pathological conditions of the mouth arising which might make it desirable to have the piece out of the mouth for a time, if it is a fixed bridge which the patient is wearing, it will be necessary to cut and mutilate it in removing so as perhaps to destroy it, while a removable bridge can be detached almost in an instant.

Last, but not least in importance is the fact that the making of removable bridgework is conducive to finer workmanship, as it requires far more skill than does fixed work. A great deal of fixed bridgework is put in the mouth, finished or unfinished in a manner which it would not be if it were possible for the patient or for another dentist to remove the piece for inspection. Of course this should not be, but it is so, nevertheless, and there are probably few who will dispute the truth of this assertion.

The only objection that can possibly be made to bridgework in cases of this kind is that for either a fixed or a removable bridge it is generally necessary to devitalize at least one of the teeth which are to serve as abutments.

It is not the intention of the writer to enter into any discussion at this time as to whether or not it is good practice to sacrifice a living pulp in order to anchor a bridge, but an experience of fifteen years seems to show that

a devitalized tooth will give as good support and stand the strain equally as well as one in which the pulp is alive. This seems to prove that it is perfectly justifiable to sacrifice one tooth, where by so doing the patient is given the use of many. Not only the teeth which have been lost, but the occluding teeth as well are brought into use, restoring their normal function which is necessary to keep them in a healthy condition and prevent them from elongating and being gradually thrown out of the mouth. It is a case where the end justifies the means.

Bicuspid Abutment. One of the cases most commonly met with and which we will first consider, is that in which the lower first molar or first molar and second bicuspid have been lost, with the inevitable result of the tilting forward of the second molar, partially closing the space and not only destroying the articulation of the teeth immediately involved, but frequently changing it all around the arch. (Fig. 1.) Of course this space can be filled by crown-

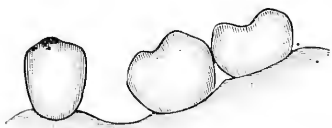


Fig. 1.

ing the molar and exaggerating the contour so as to bring it in contact with the bicuspid, or by swinging a dummy to the crown. This might prevent further change, but the great mischief has already been done and wherever it is practicable, the patient should be referred to the orthodontist whose services are here clearly indicated; but it is useless to think of restoring these teeth to their normal position and correcting the articulation, unless there is to be some appliance made which will permanently retain them in their places; otherwise there would be a quick return to the abnormal condition.

There are several different styles of abutments, any one of which may be indicated according to existing conditions, and also different ways of making a bridge for a case of this kind. As a general thing it is necessary to devitalize but one tooth when there is but a short space to be filled in, and that is the one which is to serve as the principal abutment. By the principal abutment is meant the one which forms the main, or retaining support. Which tooth this shall be, depends upon the condition of

the two supports and the particular kind of a bridge that is to be used. If the bicuspid is somewhat decayed or broken down, it is generally well to make this the principal abutment. The tooth should be devitalized, the canal somewhat enlarged and the apex filled. In the mouth of a lady, or of a gentleman where a gold crown would be at all conspicuous, it is best to cut the tooth down nearly to the gum line and prepare the root in the same manner as for a Richmond crown, by entirely removing the enamel and leaving the root so that its greatest diameter is about one-sixteenth of an inch under the gum. A band of No. 30 gauge coin gold is fitted to it, carefully festooning to follow the margin of the gum, after which the end of the root is cut down to a point just below the gum on the buccal side, but leaving it about one-sixteenth of an inch above it on the lingual side. (Fig. 2.) The band is now replaced and marked around the inside close to the edge of the root with a sharp instrument. The canal is then enlarged to the size of the tube which is to be used. If a gold bridge is to be made, the reamer should be leaned toward the lingual side, thus slop-

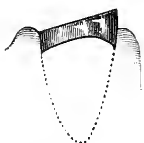


Fig. 2.

ing the enlarged canal in that direction, so that when the tube passes through the floor there will be ample room on the buccal side for the facing. If there is sufficient depth to allow of using a porcelain bridge, it is enlarged on a line with the canal. The tube is then placed in the canal and a plaster impression, just large enough to keep the relation of the band and tube, is taken.

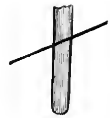
A small model is then made, the inside of the band and the outside of the tube having first been given a very thin coating of wax to facilitate their removal from the cast. The band is now cut off to the line and flush with the end of the root, filed so that it is perfectly flat and a floor of No. 28 gauge coin gold sweated or soldered to it. A hole is next made in the floor and the tube waxed and soldered the same as the pin in a Richmond cap, after which the open end extending above the floor is cut off and the cap finished and polished. (Fig. 3.)

The removable part of the abutment is made as follows: The pin of

half round iridio-platinum or of platinized gold wire, is bent double, the ends just caught with a little pure or coin gold, and filed or turned to exactly fit the tube in the cap. (Fig. 4.) A floor of No. 28 coin gold, or of iridio-platinum, if the piece is to be of porcelain, is then drilled so that the pin will fit tightly and waxed in place, removed, invested and soldered. (Fig. 5.) After cleaning in acid, it is replaced on the lower cap, trimmed even with the sides all around and a half band of No. 28 coin gold or iridio-


Fiq. 3.


Fiq. 4.

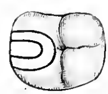

Fiq. 5.


Fiq 6:

platinum fitted to the lingual side, reaching only to the gum line, and toward the buccal side to a point about where the facing will reach, when it is waxed, removed and soldered. (Fig. 6.) The inner cap is then placed on the root and is ready for the impression and articulation.

If the attachment has been accurately made and fitted, it will not be necessary to devitalize and crown the molar. This minor support can be prepared in the following manner: A cavity is made in the mesial side of the crown of the molar, extending back about half the length of the


Fiq. 7.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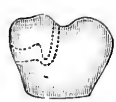

Fiq. 9.

occlusal surface. (Figs. 7-8), and a hard gold filling inserted. It must be very thoroughly condensed and preferably made of No. 60 rolled gold, as this makes a denser filling. A groove is then cut in the filling and is countersunk at the distal end far enough from the mesial so that there will be no possibility of its giving way under the stress of mastication. (Fig. 9.) If the upper teeth have elongated, they should be ground away to the normal line and carved so as to represent the natural cusps and preserve

the inclined planes. The articulation should be taken in plaster of Paris, as in this way only, can the correct occlusion be gotten. If a saddle is to be used, it should be struck up and connected with the abutments before the articulation is taken. (Fig. 10.) The model is then prepared and the bridge made and finished. (Fig. 11.) It is best to put an orange wood stick or something between the abutments to keep the space from closing up while the bridge is being made, as sometimes the teeth will move very rapidly. The spur can be made of round iridio-platinum or platinized gold wire of No. 14 to 16 gauge. A bridge of this kind is very strong, the spur resting in the gold filling in the molar getting the full support of that tooth and the hook overcoming the possibility of the teeth spreading, while the split pin and half band hold the piece rigidly in place. If it is to be a porcelain bridge, a very thin piece of mica should be placed between the halves of the pin to prevent their being soldered together while the piece is being fired.

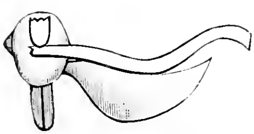


Fig. 10.

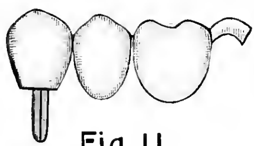


Fig. 11.

Molar Abutment. Where the molar is to be the principal abutment, the attachment is made differently from the bicuspid. A simple telescope crown will not answer where there is to be but one principal attachment to a bridge unless the crown be very long, which is very seldom the case; but if there are two principal abutments, they will do the work satisfactorily.

There are several different styles of abutments which can be used, but only two will be described, one where the tooth is ground away for a cap and the other where the natural crown of the tooth is preserved. The first of these is the combination of the telescope crown with the tube and split pin and forms one of the best of abutments for cases of this kind. The tooth is devitalized and prepared as for a full gold crown, being cut low enough to allow of placing a good thick cusp. The band is then made so that its sides are exactly parallel, or very slightly larger at the neck, fitted to the tooth, going about one-sixteenth of an inch below the gum and marked around the inside even with the top of the stump. A tube of suitable size is used, resting it on the floor of the pulp chamber, or if this

is very shallow one of the canals can be enlarged for a little distance, and the tube adjusted in place so that it is exactly parallel with the sides of the band. (Fig. 12.) An impression is now taken to preserve their proper relation, the band and tube waxed in the same way as described in the bicuspid attachment and the model made from hard plaster. After it has been separated, the band and tube are heated slightly and removed. The band is then cut off even with the top of the stump, filed perfectly flat and a floor of No. 28 coin gold sweated to it, after which the tube is fitted and soldered and the cap finished as in the case of the bicuspid. The whole inside of the band is then given a very thin coating of wax and

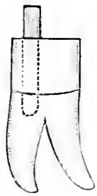


Fig. 12.

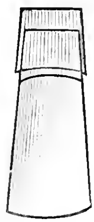


Fig. 13.

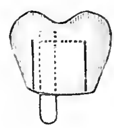


Fig. 14.

it is filled with fusible metal. The outer band is made a little small and driven over the reinforced inner cap to within about one-sixteenth of an inch from its lower edge, so that it will only reach to the gum line and not go below it. (Fig. 13.) It is then cut off and filed flush with the inner cap and the floor sweated to it. The contour is now put on and the split pin soldered in place, letting it extend a little above the floor so that it may be firmly attached to the cusp. After the cusp has been selected, the under surface is filed perfectly flat and soldered to the cap, a hole having first been cut in it to receive the head of the pin. After it is finished and polished, it presents the appearance of an ordinary contoured full gold crown. (Fig. 14.) The bicuspid is prepared in the same way as the molar previously described, the filling being inserted in the distal side to allow of having a good thickness of gold between the spur and the tooth structure, grooved and countersunk, after which the inner cap of the molar is put in position, the articulation taken in plaster and the bridge made as in the previous case.

Inlay Abutment.

The other attachment which will be described and to which the writer has given the name of "Inlay Abutment," has proven very satisfactory for years and is as follows: The molar is devitalized and cut out on the occlusial

surface about one-half the length of the crown and down on the mesial side to allow for a heavy round bar of about No. 13 gauge and a good thickness of gold. (Figs. 15-16.) The pulp chamber is filled with gutta percha and the cavity shaped about as in (Fig. 15), leaving the sides curved and non-retentive. Pure gold of No. 34 or 35 gauge is then burnished into it as for an inlay, care being used to have the margins perfect. A hole is then made near the distal end of the matrix and through the gutta percha to the floor of the pulp chamber and in it is placed an iridio-

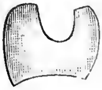


Fig. 15.

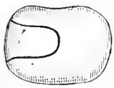


Fig. 16.

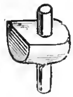


Fig. 17.


Fig. 18.

platinum tube large enough to take a No. 13 or No. 14 wire pin. Wax is packed tightly in the matrix and around the tube. It is then removed and after placing a piece of pure gold across the front so that it can be entirely filled to that point, it is invested and filled with coin gold, thus making a perfect gold inlay with a tube extending through it. (Fig. 17.) A groove is now cut from the tube to the mesial end of the inlay. The bulk of the cutting can be quickly done with a thin, round-edged carborundum wheel (Fig. 18), and finished with a fissure bur of the same size (Fig. 18) or slightly larger than the inside diameter of the tube. A flame-shaped

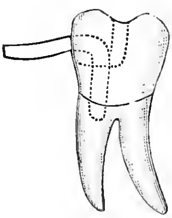


Fig. 19.

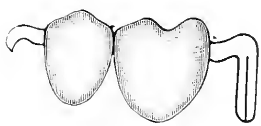


Fig. 20.

finishing bur can be used to round the corner at the entrance to the tube and to give a slight downward slant to the mesial end so that the bar will not come above the cusp of the dummy. Fig. 19 shows a section of the inlay and tube in position in the tooth with the bar and pin in place. The bar and pin is made of half round iridio-platinum or platinized gold wire, bent double and soldered to within about a quarter of an inch from the end and filed or turned to exactly fit the tube and groove. It is then bent so that it will lie in the groove closely and the closed end filed so that the

pin can be slightly opened, giving it a spring which will hold the piece firmly in place. The bicuspid is prepared with the grooved and countersunk filling. The inlay with the pin in position is then placed in the tooth and the articulation taken in plaster, the inlay coming away in the impression. The model is then prepared and the bridge made, the bar being soldered solidly into it. (Fig. 20.) When it is finished, the sides of the inlay are roughened or grooved slightly and it is connected with the bridge and cemented as though it was a fixed piece.

This attachment has been employed with great satisfaction for a number of years in molars and in a few instances in bicuspids, but good judgment must be used, as the bicuspid is a much weaker tooth than the molar. It has also been used for a long time in a modified form for gold crown abutments with unvarying success.

Cuspid Abutment.

In cases where the bicuspids have been lost, the writer has for many years made use of the split pin and tube, with the hooked spur resting in a filling in the molar. The cuspid is devitalized and the canal enlarged to the size of the tube to be used. The split pin is made and bent in the desired form and with the tube is placed in position in the tooth, the impression and bite taken and the bridge constructed. When it is completed, a little wax is put around the pin at the entrance of the tube to prevent any cement from working into it and the piece is cemented. When the cement has hardened the bridge is removed, the rubber dam adjusted and after a little of the cement has been cut away from around the end of the tube, a tightly fitting polished steel mandril is inserted and a gold filling packed tightly into the cavity around the pin and over the end of the tube, thus perfectly sealing it in so that there is no possibility of the cement washing away. The pin is then removed and the filling finished and polished. This makes a serviceable attachment and has also been used many times in restoring upper central or lateral incisors which have been lost, and even when all of the incisors have been gone, by using both of the cuspids.

When one of the centrals are missing, the tube can be placed in the remaining central and the hooked spur in a gold filling in the lateral, just at the basilar ridge. When a central and lateral are lost, the tube is put in the cuspid, and the spur in a filling in the remaining central. It also forms an excellent support where the first bicuspid and lateral incisor are gone, the cuspid being tubed and spurs from the dummies resting in the central incisor and second bicuspid.

The advantage of the hooked spur is that it prevents the teeth from spreading, at the same time giving a strong support and also affording a slight natural movement to the teeth, which is desirable.

The student of the history of dental art cannot have failed to notice

the tremendous improvement in method and scientific conception of the objects to be obtained by restorative operations of the modern type as compared with those of our predecessors. Improvements are being constantly made and strenuous efforts are being put forth in these latter days for the attainment of ideals in dentistry not conceived by our forefathers. Nothing has contributed so much to this satisfactory state of affairs as the respectful consideration which the majority of our profession accord to the importance of underlying principles. The reduction of orthodontia to a sytematic basis, which has been made possible by the enunciation of Angle's classification, has contributed much to our advancement, but its applicability is by no means limited to the correction of malpositions of the teeth, for it should be and must be the foundation of all the restorative procedures of prosthodontia, including crown and bridge work.

If I have succeeded in commending this fact to your favorable consideration, I shall have attained the object for which this paper was prepared.

A Case of Unilateral Luxation of the Mandible of Long Standing and its Correction.

By Dr. Robert Dunn, San Francisco, Cal.

That the possibilities of the Baker Anchorage have not yet reached the limit is proven by the case which I will report to you and which I believe to be unparalleled.

At least I think you will agree with me that it is above the average in interest, not so much from the nature of the malocclusion, as from the fact that it yielded to treatment to which those of its class are supposed seldom, if ever to respond, especially after maturity.

The case belongs to the subdivision of Class III, Angle Classification. (Fig. 1), and the patient is a young lady past twenty years of age and in very poor health.

At one and a half years of age, the left superior central incisor was lost through accident, resulting in a contracting upper arch and a partial closing of the space occupied by the lost tooth by the eruption of the first permanent molar of the same side.

As the permanent central made its appearance, there not being room for it, the deciduous lateral was extracted, likewise the cuspid to make room for the permanent lateral. Consequently that half of the arch failed

to develop its normal length and the permanent cuspid was forced to erupt into labial occlusion.

Why the teeth in the right half of the upper arch should erupt into lingual occlusion instead of those in the left, I have been unable to determine.

As the deciduous teeth probably remained in the mandible their full time, the latter developed normally.

At the age of fifteen and within the same month, the lower left and upper right first molars were extracted because of caries, and the upper left first premolar to make room for the cuspid.

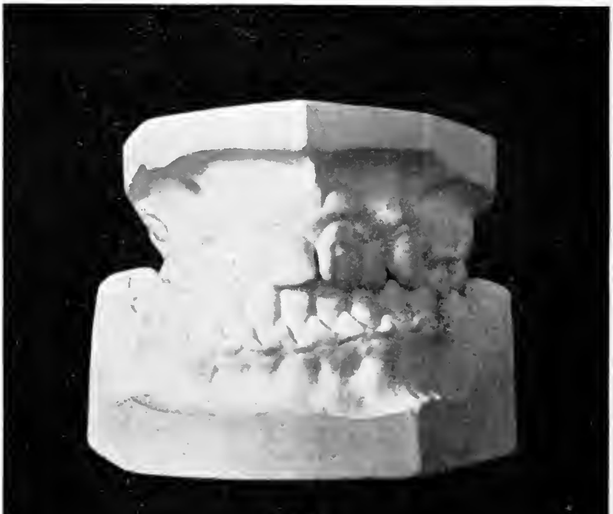


FIG. I

From this time dates the luxation of the mandible as seen in photographs Fig. 2 and 3, the former taken before the extraction, and in which it is shown to be in its normal position, and the latter taken one year after the extraction in which can be seen a lateral position of the mandible.

From these facts, it was concluded that the then existing malocclusion was such, that in the tipping of the lower left second molar mesiolingually, the lower right first molar lingually and the mesial movement of the upper right second molar, combined with the influence of the inclined planes of the teeth and the contracting upper arch forced the mandible to the right.

The treatment outlined at the beginning was to widen the upper arch mainly by carrying the right half bucally, move the teeth in the left half mesially half the width of a premolar and those in the left half of the lower arch distally the other half of premolar, also to rotate the teeth that were in torso occlusion. Angle D. bands and E. ribbed arches were used both above and below.

After one month of treatment in widening the upper arch, it was noticed that the mandible was shifting to the left.

In the two weeks following, it had moved about one-third of the distance of the misplacement and there rested.

For the next three weeks no further change was perceptible although widening of the upper arch was continued.

Fig. 2.

Fig. 3.

I then placed the Baker anchorage on the left side using a No. 9 Faber rubber band doubled and at the end of ten days there still continued no change. The No. 9 rubber band was then replaced by two No. 8 doubled.

This change was made in the afternoon and during the night the condyle slipped back into its normal position, accompanied by considerable pain in the region of the articulation, probably due to tension on the ligaments and on the bringing into use again of the interarticular fibro-cartilage.

The pain gradually subsided in the next twenty-four hours reoccurring if tension was removed.

In the following three weeks the tension was gradually diminished to one No. 8 single which was allowed to remain for retention, while the movements of the teeth were carried on.

Up to this time no mesial or distal movement of the teeth in the alveolus of either the upper or lower arch had been attempted or had occurred.

FIG. 4

Fig. 4 shows the case as it appeared after the appliances were removed and while not entirely completed, it was deemed advisable on account of the health of the patient to retain it and finish at some future time.

The mandible was retained with spur and plane, the plane being cut from a nickel and was so formed that when soldered to Angle clamp bands, numbers one and two on lower left second premolar and second molar respectively, it served as a temporary bridge as well as a plane. The spur was fastened to a clamp band on the first molar above. Bands on cuspids joined by a piece of G wire resting upon the lingual surface of the incisor, bands and spurs on the teeth that were rotated and rubber plates above and below formed the remainder of the retention.

Fig. 5 shows the patient before treatment and Fig. 6 as she appeared after treatment.

It is generally supposed, I believe, that luxations standing for any con-

siderable length of time and after maturity are rarely corrected other than by surgical operations and then not always successfully.

If this be true, then the questions arise: Why did the mandible in this case shift back part of the misplacement and then respond to the treatment that was used to force it into its normal position, knowing as we do from photographs and from models (not now in my possession) obtained when the patient was seventeen years of age, that the luxation existed for over three years?

Fig. 5.

Fig. 6.

I will state here that the treatment of the malocclusion at the time the mandible rested, had progressed to such a point that there could have been little or no opposition on its part to the further migration of the mandible.

What was the condition of the temporo mandibular articulation? Was there resorption of the eminentia articularis and a flattening out of the condyloid process?

Dr. Cryer tells us that such can and does occur in some cases.

Also what change, if any, occurred in the glenoid fossia?

Radiographs being impossible, several articulated skulls were examined and in placing the mandible in as near the same position as possible, as that of the patient, the condyle rested upon the articular eminence.

Although I have given this case considerable thought and study, there are yet many points about it in my mind that are unsettled, therefore, I will make no attempt to answer these questions, but will leave them to the society, knowing that there are those present who will be able to shed some light upon the subject.

Discussion.

Dr. Edward H. Angle, St. Louis, Mo.

Mr. President: I am proud of the result that Dr. Dunn has gained in this quite remarkable case. This sort of case is known to all of us who have had anything like an extensive practice in orthodontia, and yet I believe that this is the first one which has been treated in a manner that we may call successful. I believe it is a record maker.

Since we have had the Baker anchorage none of these cases have presented to me. I tried the treatment of some three cases previous to that, however, but depended upon the headgear and chin retractor for swinging the jaw laterally and backward, but of course you can see this is not good mechanics, for one-half of the force was received on the normal side. I tried these cases faithfully, but in not one instance did I succeed. If we could have had the Baker anchorage then it might have been possible to accomplish much.

I shall be interested to know the further history of this case. It is not enough to know it at this stage. We must know it five years later and see whether the socket has become modified into normal relation with the head of the condyle so that it will remain there. This, I have little doubt, will be the result if no accidents occur.

I cannot account for the rapid movement in Dr. Dunn's case.

Dr. S. M. Weeks, Philadelphia, Pa.

This paper is along certain lines that have given me a great deal of thought, and that is the relation which the temporo-maxillary articulation may have in cases of the second and third classes. It seems to me that if these cases could be treated at the proper age, bringing about the necessary change in the temporo-maxillary articulation, they may result successfully without an extended movement of the teeth in the alveolus. I have had several cases where the occlusion has been such as to bring about a loss of the mesio distal relation and it appeared that the abnormalities were confined to the glenoid fossa. In one case of typical

Class II Div. 2 the superior centrals were retruded with protrusion of the laterals. It appeared that the mandible as a whole was in distal occlusion, rather than within the alveolus. I first removed the obstruction to the mesial movement of the mandible caused by the superior centrals; then with a Baker anchorage applied for ten days, the two arches were placed in proper relation. This case was treated at the college and was allowed to go away without retention. I saw the case again about four months later and while the centrals had returned slightly to their previous condition thereby causing a like return of the mandible to its former position, yet the relation was normal, so that with a very little change in the superior centrals the lower arch came back to its normal position without help and where it remains at this time without retention. I believe that an abnormal temporo-maxillary articulation was changed to a normal one.

We all understand, I think, that in childhood the glenoid fossa is considerably larger than is necessary to accommodate the condyle. The interarticular cartilages are thick and pliable, and it seems quite possible for the angle of the jaw to acquire an abnormal position in the cavity without in any way affecting the osseous tissue. And with a very little trouble we can bring about the normal relation and we also can maintain it without difficulty.

This is a very interesting feature of these cases and one that should have the special attention of orthodontists.

Dr. F. C. Kemple, Erie, Pa. I would like to ask Dr. Angle whether he has had radiographs made of any of the cases in which he brought the mandible forward so as to show what change had been affected in the articulation.

Dr. Angle. I have had a number made but they amounted to almost nothing, being so indistinct that it was impossible to trace with any accuracy the outline of the parts in question. Only one have I seen that was at all clear and of any value, and this seemed to be an accident in photography. I sincerely hope that this branch of photography may yet give us what we so greatly need.

Dr. Kemple. It seems to me that the glenoid fossa and the hip-joint are in an analogous condition. Dr. Lorenz, in operations on the hip-joint showed us that by moving the bones forming a joint, you can form a new joint or place of lodgment for the bone. And the same thing is possible in the temporo-maxillary articulation, and I would like to know what is the condition in that joint after such an operation. The fact that in the case reported the change took place in a night is rather remarkable.

Artificial Substitutes for Missing Teeth in Orthodontia.

By Joseph Head, D. D. S., M. D., Philadelphia, Pa.

The problem of supplying the ravages made by ill-advised extraction in the regulation and straightening of children's teeth is one of appalling difficulty if the work is to be done permanently and satisfactorily, while the child is young and the gums and teeth are in a constant state of varying relationship.

Any piece or appliance that can be made to fit the gums of a child of eight or nine years, will of necessity not fit those gums when the child reaches the age of twelve, and any piece which is made at twelve years, will correspondingly not fit when maturity is reached. In the same manner, to carve teeth sufficiently for a bridge without destroying the pulp is practically impossible, from the fact that the teeth are hypersensitive and the patience of the child is not equal to the strain. If the pulps in the teeth are destroyed at so early an age, great injury is done to the teeth, as a foramina of the roots are not fully formed, and the dentine has not received its normal proportion of calcified structure.

Viewing these obstacles in a judicial light, they must appear insurmountable, and, therefore, any bridge that shall permanently replace a tooth that has been unwisely extracted, must not be inserted until the child has reached the age of maturity, and the gums and tooth structure on which the bridge is to be built have ceased to change materially. Therefore, it would seem the wisest plan in such cases to get the space required for the proper occlusion of the upper and lower teeth, to band the teeth adjacent to that space, and to solder a bar between these bands and to cement the bands into position, thus holding the teeth in normal occlusion, until the proper time and proper development will permit the permanent, or rather so-called permanent bridge to be constructed; for in spite of the advance that has been made in prosthodontia, the permanency depends upon how long the patient lives. Of course, the bar that holds the two teeth apart should be so adjusted as to receive the occlusion of the upper teeth in such a manner as to prevent the elongation of the occluding teeth.

The bridge most suitable for a molar or bicuspid space, in my opinion, can be made as follows: A gold cap should be made on the tooth posterior to the space. It should, of course, fit the neck of the tooth at the gum perfectly. To this tooth the missing tooth can be soldered with a small lug to rest upon the grinding surface of the tooth anterior to the

space. This will allow the natural mobility of the teeth to be maintained, and will also allow floss silk to be used in such a manner as to make it possible for the teeth to be kept absolutely clean.

This plan is feasible with any bicuspid or molar space, but when the superior lateral incisors are missing, and all the rest of the teeth have come in normally, it sometimes seems advisable to follow another plan. The difficulty and discomfort that always arises from replacing lost lateral incisors where there are no roots, is so great that we, as dentists, are averse to saddling a small child with such an enormity.

The upper cuspids should be brought forward adjacent to the superior central incisors, and the first upper bicuspid should be brought into position normally occupied by the cuspids. The lower first bicuspids should be extracted, and the lower cuspids drawn back into their sockets, thus allowing them to fit between the upper cuspid and the first cuspid. The points of the upper cuspids should be taken off slightly, so as to make them look a little more like the laterals that they replace, and the external cusps of the first bicuspids should be relied upon to give the appearance of the cuspids.

This I am well aware is a radical operation, perhaps much open to criticism, but in my opinion and in my experience it has given good results, and I take great pleasure in showing a set of models that represent such a case finished, which came to me during the course of my practice.

Discussion.

Dr. J. Lowe Young, Detroit, Mich.

I have had some experience in bridge work, but Dr. Head presents a different phase of the subject from that which I have been engaged in. Of course, bridges must be inserted in cases where teeth have been lost, if we are going to get the best possible result. But I do not believe it advisable to do so while the patient is very young. In such patients the size of the pulp is such as to render proper preparation of the tooth very painful with great danger of subsequent death of the pulp. By the use of cataphoresis, I believe such cases can be successfully treated. I have treated many cases for adult patients with perfect satisfaction, where the teeth were so sensitive that they could not endure having them ground sufficiently so that a cap could be properly fitted. By the use of this much abused appliance I have been able to so obtund sensation, after making an opening into the dentine on the occluding surface, that all the remaining enamel and bell portion of the crown could be entirely removed without causing the slightest pain to the patient. It is a well known fact that the most sensitive portion of a tooth (except when the

Cataphoresis in Crown Work.

pulp is reached) is at the junction of the enamel and dentine; and I do not believe there is any more danger of the pulp dying when the dentine is ground away sufficiently to allow of the proper fitting of a cap than where the dentine has been merely exposed. In all such cases the dentine should be treated with silver nitrate, thus closing up the dentinal tubuli and giving a perfect barrier against the action of the phosphoric acid when cement is used as well as rendering the pulp immune from shock from thermal changes.

Whether or not the action of electricity in forcing the cocaine into the dentine will act as an irritant and cause an acid in the blood I am not prepared to say, but I have never had a case so treated give any trouble. But to me it seems if the current is properly used and the dentine thoroughly numbed, that there is much less danger of there being acid formed in the blood than where the tooth is ground without being so treated as there is much less irritation. Then by the use of gutta percha cement for fastening the bridge in place, the great source of danger to the life of the pulp is removed, namely the prosphoric acid of the cement. With bridges fastened in this way, their removal is very simple in case of subsequent trouble.

Lost Laterals.

I cannot agree with the essayist on the question of closing up the space caused by the loss of one or both of the upper laterals. We all know how unsightly a person looks where the cuspids are placed beside the centrals, and by removing the lower first bicuspids in order to harmonize the size of the arches, the facial lines are so marred as to be very unsightly. And this is not all, for by careful measurement we find that the width of the upper lateral does not correspond with the width of the lower first bicuspid. So if the normal occlusal relations of the molars are maintained in both arches, it must necessarily follow that there remains a disagreeable space between the cuspids and centrals or else between the cuspids and first bicuspids in the upper arch.

In such cases where the patients are young, it would seem advisable to swing in the missing lateral on a spur soldered to the retaining appliance to be worn as long as possible and then put in a permanent fixture by either crowning the cuspid and fastening the lateral to it, or by using the staple attachment on the cuspid to carry the lateral. By the last method it is not necessary to remove the pulp from the cuspid and there is no gold to show.

Dr. R. Ottolengui, New York City.

Dr. Head is mistaken in thinking that the upper tooth that is most often lost in these cases is the sixth year molar. The race of men who extract the sixth year molar for regulating are nearly all dead. But

the men who extract the first bicuspids unfortunately, are still living; and it seems to me that it is the biscupids that we would be most often called upon to replace in order to get proper occlusion.

Lateral Incisors. The tooth that is really missing most often is the lateral incisor, and we do not always have to deal with the fool dentist. It usually is due to absence of the tooth germ. Those cases that come to us with the lateral incisors absent, and cuspids close to the centrals are the ones in which we try to make space and get laterals in.

We should not attempt to do anything permanent in these cases and I see no reason why the retaining fixture which is made to retain the arch, cannot be made to carry the laterals for a long time. I have seen a fixture for carrying the lateral incisor permanently in the mouth of an adult, which I think, might be adapted for these cases. When I saw this fixture I was very much surprised to see how well it was doing the work. The fixture was a crown over a molar, a long way farther back then was suggested here today. From that molar a heavy bar was extended in such a way as to avoid the occlusion of the lower teeth and to curve forward in proper position to carry the lateral. The bar was made so rigid that in spite of its length there was perfect immobility. The tooth rested against the gum and was not more movable than any other tooth in the mouth. The man had been wearing the fixture for over ten years; but, better than that in these young mouths, would be an open band instead of a full crown, so as not to mutilate the molar teeth at all; I say better, taking into consideration the fact that this is simply a tentative procedure, and that some other method is to be adopted later in life. I would put a band on the molars on both sides, and run along the roof of the mouth a heavy bar; from that another heavy bar to carry the lateral incisor. I am positive that such a fixture could be worn for many years without injury to the teeth, especially if the bands are made from soft gold so that it can be burnished both top and bottom when the cement is being put on.

I take it that a fixture of that kind to carry a lateral incisor would be worn for only three or four years; then the teeth would be fully developed, the jaws all formed, and you can decide what permanent fixture to put in. Even if the foramina are closed at the age of eight or ten, the teeth themselves are not fully developed at that time. The pulps are large; the dentine is not completed; teeth become more solid all the time, and the later in life you remove the pulps from living teeth, the better the result. So that we need not worry so much about this. We need hardly ask our bridge working friends how to do it, because if we can make a retaining fixture to hold the arch, that really is all we need to do.

Dr. Burt A. Abell, Albion, Mich.

One or two things have occurred to me where the lateral incisor is missing and where we have no tooth germ. Some time ago Dr. Young showed me a shell crown that he makes of porcelain, and it has occurred to me that in replacing these laterals the first bicuspid could be covered with one of these porcelain shell crowns, with a platinum matrix and a heavy iridio-platinum bar swung back of the cuspid and the lateral soldered to that. The space is preserved, the tooth is brought into place, and a retaining band covered with porcelain, is not a disfigurement. The face is filled out because all the teeth are there and occlusion will be normal.

Dr. Richard Summa, St. Louis, Mo.

I desire to discuss this paper from the standpoint of one who has assisted in arranging the programme of this society, whose object is the advancement of orthodontia and its establishment as a science. To fulfil this purpose, we must necessarily draw upon the collateral sciences and arts for such of their knowledge as relates to our specialty. It is for this reason that this symposium of prosthodontists on the subject of the substitution of missing teeth in orthodontia is being presented at this meeting.

We have had the good fortune to have met with an artist who taught us the correct relation between orthodontia and facial art. I refer to Mr. Edmund H. Wuerpel, of St. Louis.

Among the transactions of our last meeting can be found the highly instructive contributions of Dr. Kirk and Dr. Cryer upon subjects of anatomy in relation to orthodontia.

We have endeavored to establish the correct relationship between rhinology and orthodontia, but, I am sorry to say, up to date our efforts have met with but moderate success.

Strange as this may seem, it is to my mind more surprising that the prosthodontist who springs from the same parent as orthodontia, the art and science of dentistry, should fail in such degree to harmonize his work with the demands of orthodontia. For, is not occlusion also the basis of all operations in prosthodontia and is not the restoration of the normal facial lines equally demanded of prosthodontia and orthodontia?

I wish to enter an emphatic protest against Dr. Head's suggestion in regard to the correction of the abnormality produced by the absence of an upper lateral incisor. He suggests that we move the cuspid into contact with the central incisor, turn ourselves into odontocides and extract a lower first bicuspid to compensate for the missing upper lateral.

An appreciation of symmetry and facial art and a study of occlusion

will prohibit any one from suggesting such a procedure, not to mention putting it into effect.

What we have heard at this meeting from the field of prosthodontia forces upon me the conviction that there exists a great need for the gathering of the prosthodontists in a society for the advancement of prosthodontia as a science and in order to achieve this result let them draw upon art, orthodontia and other correlative subjects for enlightenment.

Dr. Head. The point made by Dr. Young that teeth could be crowned painlessly by using cataphoresis is a very interesting one, but we should remember that when a tooth is denuded of its enamel in such a way as to cause profound irritation, even though that irritation is at first brought under control by means of cataphoresis, we tend to make a morbid condition in the pulp through inflammation, and we make the pulp unhealthy, perhaps, through the deposition of lime salts. This is a very serious objection to such extensive work as would be necessary to be carried on before any tooth could be prepared sufficiently to allow a band to be fitted around the neck.

Concerning the other points made, the thing that interested me most was the method of having bands attached to the first bicuspid and porcelain put around them. Such a band is subject to lateral strain that would peel off the porcelain and make a very unsightly piece of work. Any one who has gone through the preliminary stages of porcelain bridge work will know that a thin piece of porcelain put over a band is in a precarious condition. The porcelain is weak unless there is sufficient body to it to withstand the strain.

Although I do not remember saying in my paper that the first permanent molars are the teeth most often found missing, I cannot but feel that it is true, and according to my experience and the teachings of men in this country and abroad it is true. When I was studying dentistry there was a regular furore all over the country, the first permanent molars should be extracted, they said, in order to allow the second molars to take their place.

How Much Orthodontia Should We Attempt to Teach Students in Dental Colleges?

By N. S. Hoff, D.D.S., Ann Arbor, Mich.

Two considerations or conditions suggest the inquiry which we propound to this Convention, with the hope that some light may be thrown upon the subject by you gentlemen who have especially prepared yourselves for the practice of this branch of our work as a specialty.

The first is that the subject is not now satisfactorily taught in a comprehensive and systematic manner in many of our dental schools. It is true that in a more or less careful manner it has been taught in all schools for the past thirty years; and owing to the fact that here and there an occasional genius at this work has been connected with some school, for a short time at least, something creditable has been done in that particular school. In a few instances the work has been very well done, and sometimes to the extent of taking out time belonging to other technical studies and work of an equally important character. But the nature of the work in itself and the complicated methods of treatment in vogue, have made the subject one to which it has been difficult to give a suitable proportion of the time available in the curriculum of our short term schools without encroaching on time of other important studies.

The second reason for the inquiry is drawn from the fact that there seems at this time to be springing up a sentiment that this work has assumed a sufficiently important place to entitle it to be set apart as a distinct specialty, and that those who engage in this specialty should give up all other practice; in fact, it has become necessary for those contemplating this kind of practice to attend and prepare themselves at schools, or with individuals, giving no other instruction, except in such subjects as have a direct bearing on the practice of orthodontia.

Difficulties Met in Teaching Orthodontia.

What are some of the conditions which have rendered it difficult to give instruction in this subject? A moment's thought will convince every one that the lack of definite knowledge as to the causes of irregularities of the teeth and systematized methods for correcting them have been the great stumbling blocks that have hindered perhaps more than all else. It may be well to say, without stopping for full comment, that this phase of the subject is being rapidly cleared up at the present time. In the very near future, through the efforts of scientific investigators, the use of appliances now available for diagnosis, and because of therapeutic researches by specialists in other than oral specialties, diagnosis at least, will be made sufficiently definite for successful teaching. The same optimistic view can also be taken of the technical treatment, in view of the wonderful ingenuity of the large number of expert practitioners who are taking up this work as a specialty. Appliances are simpler in construction and are made with mechanical precision as never before. In this particular we may hope for teaching material of an entirely satisfactory character, if we do not already have it. The nose and throat specialists, the X-ray pictures, and the several varieties of appliances on the market at reasonable prices, seem to have nearly solved this part of the problem.

The most formidable difficulty is encountered when we undertake to give instruction in this subject to the large classes in colleges. Very few students will take more than a *passing* interest in the subject. Of course, this condition may in most cases be accounted for by the fact that the teacher does not have sufficent skill or knowledge of the subject to command the interest of his classes. This is one of the places where born and not hand made teachers are needed, possibly more than anywhere else, and without casting any disloyal reflections, there are too few of us born right. But for reasons given above many of the former tiresome and uncertain conditions and methods are giving way to definite and successful procedures, and the teacher can now go to his class with more positive assertions than ever before. And really a teacher who is alive to the value of his subject, and is abreast with up-to-date methods ought to be able to go to his class with a burning message every time. It looks very much as though we should have this kind of teachers for this subject in the future, as there are abundant evidences of greater advances in this art at the present time than any other branch of our profession.

Difficulties of Managing Clinical Cases.

There are, however, other difficulties which try the spirits of the most accomplished and ardent instructors, and one of the most pronounced is the clinical management of cases. Unless it is possible to illustrate treatment by actual cases in practice, no amount of technic work or lectures will adequately impart all the instruction necessary to even give students the fundamentals of this important work. In the first place patients to be treated in the college clinic must be on hand in the first part of the year, else the work may be prolonged beyond the end of the session, and the student misses the value of the completed object lesson, to say nothing of the trouble college authorities have in caring for such patients as are left with incompleted work, which may take on disastrous form during the interim of vacations. Students, for lack of experience and attention will not carry along the work as expeditiously as they might, and much time is wasted in unskillful adaptation of appliances. To obviate these faults the instructor is obliged to keep close watch of every case and, in fact, is often compelled to do the work himself, which, of course, is not the best thing for the student, as he loses many valuable points because he will not give that close attention to details which he should. He seems to have the utmost confidence in the ability of his teacher to do the thing properly. This, of course, does not apply to all students, but is perhaps a correct characterization of the attitude of the average student to this kind of work.

We might stop here and very profitably consider what attributes of character and professional attainment are essential for the successful prose-

cution of this work. And when we suggest that great firmness of character, and at the same time large elements of self-control or poise, and a keen sense of the value of diplomacy in handling patients the essentials which will often be called into use, it will be easily apparent that few there be that can meet these specifications near enough to be encouraged to take up this branch of practice with the hope of succeeding in it beyond that of the general practitioner, who merely dabbles in it, to satisfy his patients. One of the best tests for determining whether a student is likely to succeed in this work is to give him the conduct of a case. A large percentage will soon prove that by nature or from inclination they have no inherent ability and may never develop a taste for the work, nor enough skill to do it even moderately well. It may happen that a favorable result will claim a student's interest to such an extent, that by diligent striving he comes to possess fairly good conceptions of the fundamental principles of the art, and he takes it up with a strong desire to accomplish something worthy. A few students will take to it naturally and readily. We find between these extremes all grades of material to work with.

Method by Teaching Required.

Now the question we would ask is, is it possible to formulate a method of imparting this instruction, or of selecting the kind of instruction most needed, that can be adapted to class and clinic methods in our college course, which shall successfully appeal to the undeveloped faculties of the average students? We can readily see how practitioners can give up general practice and attend post graduate schools and take up specialties with an eagerness that accomplishes wonderful results. But such men have something historical and automatic to start with, and they know what they want to learn. But the problem of teaching students without discriminating capacities is an entirely different proposition. It is here that the problem of not only "what, when and how," must be carefully considered, but in addition the cultivation of a respect if not a love for the work which will develop latent personal characteristics, without which no one will succeed in accomplishing creditable results.

In outlining a scheme of procedure for discussion, it would seem that a course should be designed to develop the intellectual as well as the technical side of practitioners of this exacting art. It may be necessary to start with what we term the technics, much as in other branches, and accompany this with lectures on the theory and practice; adding to this clinical instruction to illustrate principles of practice in the most conclusive manner, also giving a vital relation to the study, which has a wonderful power to lead out the intellect as well as to acquaint the student with methods of handling patients.

Technic Course. In the technic course such work as will acquaint the student with appliances, their manufacture and use, would naturally be suggested as very proper. How far such a course should be carried can only be determined by the time at one's disposal and the values placed on other methods of instruction. If an endeavor were made to include in such a course actual construction of even a limited variety of all the so-called systems of appliances used for correcting irregularities, so much time would be consumed that other methods would be neglected and the student perhaps incur such a dislike for the work that he would not care to engage in it. A brief outline should at least include taking of impressions, securing models from the impressions, studying the models and classifying them as cases, especially as to cause of conditions found and treatment, and then designing appliances for corrections. This last, of course, would call for the construction of appliances and mean experimental construction or adaptation of suitable appliances for the case in hand. In our judgment this work should not be needlessly prolonged, but should be carried along systematically and conjointly with a course of lectures, in which principles, and to some extent so-called systems may be comparatively considered. This will develop interest and lead to more intelligent work of a technical character than is secured when these courses are taken in different years, as is generally the case at present.

Lecture Course. The lecture course should embrace a consideration of the etiological factors in orthodontia, including a review of such embryological and anatomical facts as may be necessary to show clearly how irregularities of the teeth and facial hard tissues have reciprocally responded to the deforming factors. Pictures, drawings and models are here introduced to great advantage, in establishing ideal or typical forms in contradistinction to irregular and unnatural ones. The anatomical relations of the teeth and their functions should also be most carefully discussed. The influence of disease of the deciduous teeth, gums and oral structures, as well as of the nose and throat should be carefully considered and so far as practicable illustrated by clinics or exhibitions of patients. The esthetic values should be given adequate attention, as this from the practical standpoint is an important consideration, since it not only furnishes one of the strongest motives for keeping patients faithful to prolonged and uncomfortable treatment, but lends interest to one's efforts to produce that harmony which nature intended. This much is surely fundamental and necessary; but now we come to the place where possibly the subjects to be taught will be as varied as the methods. A discussion of all the different appliances or methods advocated or reported as cases in our literature would consume a

great deal of time and lead the student into no little confusion as to the best method to adopt. Some teachers feel that a liberal treatment should be given all methods or systems which can be logically sustained, while others contend that it is much more satisfactory that one good method be taught thoroughly. The former method may produce superficial and immature results, while the latter is quite as likely to produce narrowness and bigotry to the extent of seriously handicapping progress. It is certain that a liberal discussion should be either made of the various methods in the class, or some plan should be adopted, perhaps a reading course, that would make students somewhat familiar with the better efforts made to find solutions for perplexing cases. Much material is available for such a course, and it could very much better be dug out by the student than to complicate the effort to present the subject logically in the lectures. We have no doubt some teachers will succeed very well on the plan of a single method, and others perhaps just as well by discussing all systems as to their relative merits, simply because there is a wide difference in their mental and habitual methods.

It may also be valuable to take up the influence which heredity exerts in producing irregularities of the teeth; or to make an exhaustive study of classic art principles that facial inharmony may be detected, and this knowledge used to influence therapeutic procedures. But should these subjects be considered adequately, much time will be used and perhaps the interest of the student be dissipated, because neither of them can be discussed profitably by a teacher who has not given them more or less exhaustive study. And he would need to be a very well balanced man to present these subjects in a manner which would enlist that sympathetic interest, which is essential to the best results. While such topics are desirable from the standpoint of culture and may have valuable practical applications, it seems to us that they are not necessarily pertinent, and should be deferred to another time when their relations may be better appreciated.

A large proportion of most lecture courses is usually given to a discussion of cases in practice and the methods used in treatment, and our text books are padded with descriptions and illustrations of such cases. Very often the same appliance or method is recommended for similar conditions regardless of the causes which produced the irregularity or those which tend to its maintenance. Too many illustrations of this kind confuse the reader just as they will confuse the student; they should only be used to illustrate and enforce principles. And the fewer principles with their variants taught, the more readily the student will comprehend them. Used in this way, the student will comprehend them. Illustrations cited also lose personal characteristics and their consequent complications, and serve to bring out principles of etiology and treatment. The large ma-

jority and especially the most frequently seen cases of irregularities can be classified under a few headings, and subjected to corresponding lines of treatment, with only slight modifications made to meet special peculiarities. It should not be necessary to notice these peculiarities in a lecture course at the risk of confusing the mind of the student. These may much better be taught in the clinic as occasion arises, or learned by the student in practice as necessary. Teachers ought to remember that their chief function is not to impart knowledge in detail, but to put their pupils in the way of acquiring it. There is nothing so stimulating to one's intellect as to discover something. It's as good as winning a battle.

In the lecture course, attention should be given to the physiological changes which take place as well as instruction as to care of pathological conditions which are liable because of accidental causes or from prolonged treatment. The toilet of the mouth is a matter of importance and should have an adequate treatment. The physical condition of patients often modifies treatment, and should be given close attention during the period of treatment, and students should be instructed in a few well chosen lectures by a medical practitioner as to what these conditions are, and how they should be handled. A few lectures on business methods will be of great advantage, as many a practitioner fails to make satisfactory business arrangements and as a result he becomes disgusted with the work and drops it for more remunerative work, when the fault has been largely his own.

Valuable and important as the technic and lecture courses may be, no course in orthodontia can be complete which does not offer an opportunity to see actual cases under treatment. Students very often apprehend more readily with their eyes than brain. This is probably the reason why our eyes are worn out before the brain shows any sign of awakening. They are overworked. The clinic is therefore essential, and as we indicated in the beginning of this paper, it is one of the most troublesome departments of instruction to manage successfully. To get the undivided attention of the student and the entire cooperation of the patient is almost impracticable. And yet if this cannot be accomplished the value of this feature of instruction may be wholly lost. It is not enough that the student shall see the case begun and then completed, and be shown the appliance used to accomplish the result. The details of management from the beginning are of the greatest value and students having charge of the case must experience and study each step in its sequential order that he may derive the greatest benefit. Mistakes made in treatment are not without value, but a mistake from beginning to end has little value educationally. A teacher should have constant surveilance of every case and students should not be allowed to direct the management of cases on their own responsibility or

in accordance with their own ideas. Where practicable every case treated should be shown at proper stages to the entire class, so that the clinical illustrations can be as widely utilized as practicable. But any one who has had charge of a clinic of this kind in a college will know how difficult it is to realize all these suggestions. Students will not meet their appointments, patients will come at irregular times, and students will see the case and the instructor does not. The instructor must do a large part of the work to keep the work going smoothly and to avoid serious blunders. While the clinic should be most instructive, it generally is also most difficult and sometimes quite unsatisfactory. A clinic conducted wholly by the instructor would be much more comfortably managed, but the question is, would the student get much out of it?

Now, I have presented my thought to you, it is true in a somewhat pedantic fashion; but I trust it will enlist your interest to the extent that a fair expression of views may be had which will be valuable to us all. If you can suggest a better scheme of presentation than I have outlined, I shall be glad to have met with you, and thank you for your considerate attention.

Discussion.

Dr. Edward H. Angle, St. Louis, Mo. This is a very important subject and the time at disposal is limited, yet this society cannot do better than to devote a portion of its time to the discussion of a topic so valuable as this—"How Much Orthodontia Shall We Teach Dental Students?" I have had some experience in this matter and it has given me some very radical views on the subject. If, in giving these views, I conflict with yours I shall do so honestly, earnestly and sincerely, and I also ask for your views given in the same spirit.

Something should be done. It is not fair either to the public or to dental students that the teaching so long in vogue should continue. I sincerely believe that no subject is taught so badly nor shows such bad results as orthodontia, not even theology. Yet it is one of the most beautiful subjects in dentistry. There is no limit to the amount of good that may be done in orthodontia, and practically no limit to the number of patients. People with money are willing to pay almost any price to have their children's teeth properly treated, but they are not receiving proper treatment. There is a deformed class growing up around us far greater in number than you, gentlemen, realize. You are wedded to the lines of dentistry in which you are most interested, and you do not notice how unsightly, warped, and twisted children's faces are from these deformities, for just in proportion as people have malocclusion of the teeth are their

faces out of alignment. You can see them everywhere and they ought to have intelligent and skillful attention.

In my opinion orthodontia never will be taught successfully in dental schools; certainly it is absolutely impossible to do so along the lines you are now following. It is a difficult subject to teach and to master; it embraces so many different lines that it requires much careful thought and a wide-awake intellect. There is not sufficient talent, aptitude and liking for it among the dental profession generally for even a superficial knowledge of orthodontia, and this is proven by the horrible advice they give and the serious blunders they commit every day in the name of orthodontia. Nor have you the right material to teach orthodontia to, and to attempt to force each student to master it during his college course is wrong. You cannot do it. I believe that there is a certain percentage of dental students who, if placed under the correct environment, would make useful and competent orthodontists, but it is wrong to try to force every student to become an orthodontist. He has not the intellect to grasp it and it is wrong for you to force him to study something that is distasteful and that you cannot, with any amount of time or skill in teaching, make him learn. I have tried it. I had fourteen years' experience in some of the best and some of the worst dental colleges in this country, and I know that my efforts were failures. Of all the students I taught there was not one whom I succeeded in teaching enough orthodontia to enable him to make a livelihood out of the practice of this specialty. Neither has any institution in this country or in the world ever turned out a student sufficiently skilled to make his living by its practice. Those who have succeeded have done so after leaving college, and in spite of their teaching, and with some of us it took long years to eradicate this handicap of unfortunate teaching.

The only men to whom you can teach orthodontia, and the only men who will ever master it, are the ones who are vitally interested; who are thoroughly in love with it; who have the ability for taking infinite pains, not only in what they do with their hands, but in the study of the subjects embraced in orthodontia. The mere tinkerer, be he student or teacher, will make but a poor showing in the modern orthodontia.

Now, surely, the student in college is not in love with orthodontia. Probably he never heard of it before coming to college—you know he comes there to learn how to fill teeth, but principally to get his diploma. You are forcing something on him that arouses his antagonism; you compel him to do that which he does not want to do. I believe many a good orthodontist is spoiled by your methods of teaching. If he has an interesting case in the infirmary other duties conflict and he must neglect it for something else. His patients are of a class that does not appreciate his work. They soon become discouraged and then stay away entirely. A

man, to become an orthodontist, must follow cases all the way through treatment. And he must have many cases. I suppose that not more than twenty per cent of our students ever begin the treatment of a case, and, I dare say, that not over two per cent ever see a case finished. Think of it.

The Four Year Course.

Orthodontia must be taught, but it must be taught far differently from what it is now. I hope the four year course will have much in store for orthodontia, as well as for other branches of dentistry which must be specialized if they are ever to be successfully taught. I have hopes that some time you will see the importance of this, and that in your teaching you will give the student a chance to do the work for which he is fitted and which he likes to do. They won't all want to be orthodontists, or crown and bridge makers, or plate makers, but they ought to have a chance to specialize according to their talents. And that is where the fourth year ought to come in. After the student has spent three years in college he has his likes and dislikes pretty well sifted, and he knows just about what line of work he would like to follow. Then, in the fourth year, give him an opportunity to follow that bent, provide him with the proper material and with competent instructors, and you will obtain a result that has hitherto been beyond your expectations and hopes. But you cannot do it with your present methods.

Post Graduate Teaching.

Some years ago I conceived the idea of forming a post graduate school for dentists who wanted to specialize in orthodontia. I had become convinced of the hopelessness of attempting to teach it to students in dental colleges. I realized, however, that there must be men in dentistry who would like to know the real orthodontia and who were not content with the mere semblance of it, and that was the reason for founding the post graduate school. And outside of finance it has been a great success. Our students come to us with matured minds, with the desire to learn. Here we teach orthodontia only, and the very air is permeated with it. No other phase of dentistry is allowed to be discussed. It is taught in the broadest and most thorough manner possible in all its different phases by the best teachers procurable. In this school there are lectures on art, rhinology, embryology, histology, anatomy and comparative anatomy of the teeth and jaws, all from the basis or central point of occlusion. We also have a generous clinic, and the result of such teaching is very gratifying as many of you know. It was only an experiment; it was not started for the purpose of making money; in fact, it has never paid expenses, but it has proved conclusively that you must specialize your teachings just as you would specialize your practice. I know from my own experience that I can accomplish a hundred times more by devoting myself to the practice of

orthodontia alone, than I could by mixing it up with all the other subjects. I know that in our little school we make more progress in one day than we did in the dental college in a whole year. Yet I do not believe that schools should be conducted in a private way. This one was forced on me because I wished to see those who had a desire to study orthodontia better receive an opportunity to do so. These schools should probably be parts of universities, and I am in hopes that some of our great institutions will soon establish proper courses of instruction in orthodontia; that they will not try to teach half a dozen different subjects at one and the same time. Such teaching inevitably makes jacks of all trades and masters of none.

Many of you will not agree with me, but that is my honest opinion based on a large personal experience with dentists and dental colleges. I have just closed a session of my school. I felt weak and ill when I started, but it was such a pleasure to teach these young men that I grew better every day in spite of the hard work. But this certainly is not true in the dental schools and I know you men who are teachers will bear me out in this. There is so much to orthodontia that you cannot teach more than a mere smattering after the plans you now follow. And further, it is an axiom that no man can intelligently impart what he does not comprehend himself, and unless the colleges of this country can provide themselves with teachers who at least know the rudiments of modern orthodontia we certainly cannot hope for very much from the students who are to be instructed by them.

As to teaching appliances and systems, there are no systems. I once believed that there was a Case system, a Jackson system, and an Angle system, but I got over that. It was all nonsense. All you want is truth. There is truth in regulating appliances just as there is in occlusion, and all so-called "systems" of appliances fade away when the subject is taught properly and broadly. No one has any trouble to know what are the proper appliances when he is familiar with the principles of orthodontia.

At our school we spend very little time on the subject of appliances, and the long tedious hours that students are now compelled to put in making worthless regulating appliances after patterns long out of date ought to be cut out. You are only making tinkers of them, not orthodontists. The man who can fit bands and do simple soldering knows all about machinery that he needs to know. I think to compel students to hammer and file and pound and draw wire, and make rubber plates, shows the ignorance of the teacher. He ought to be teaching his boys something they ought to know, for I say, better by far is it to fit each student so that in his life's work he can do some one thing well, than many badly, as is now the rule. Colleges ought to reform.

Dr. A. E. Webster, Toronto, Can. There are so many things I would like to say on this subject, that I do not know where to begin. The subject in general as laid down by the essayist is very good in a way, but it is not broad enough. I agree with Dr. Angle that it is impossible to make orthodontists of everybody, and yet every dental student should know the essentials of orthodontia. I also think that the teacher who spends his time teaching the making of appliances is wasting his energies. It is much more essential that the student should know the principles underlying orthodontia than the treatment. In teaching we should not undertake to suggest treatment. The student should have been so trained that he comes to the treatment of a case with the feeling that the designing of the appliances is merely a secondary affair; that the etiology and diagnosis of the case should command his whole attention.

In our school the course in orthodontia was designed by me, but it is not now what it was designed to be. I thought I could teach orthodontia to every student. I know now that this cannot be done; that it should not be attempted. But orthodontia is not the only subject on the curriculum; there are other equally important subjects that command their share of the student's time. Orthodontia cannot receive more than its share of time and attention. It is best to send a student out a safe practitioner in dentistry. About ninety per cent of the cases that come to the infirmary for treatment are there because of a lack of dentistry or because of faulty dentistry.

The subject surely is a very difficult one to teach by lectures. The only plan is to have every lecture illustrated in some way and to teach operations at the chair. My own method is something like this: The lectures are given in the junior year; the technique is given at the same time. I believe that every student should have a good technic training; if he does not get it in orthodontia he should get it somewhere else. If he gets it somewhere else then it is not so necessary for him to get it in orthodontia. Following the lectures comes the infirmary practice. Each student has a case assigned to him. We have such an abundance of material that we do not give the students the difficult cases to treat. We turn these cases away, and the students treat only those cases that are simple and that can be treated and completed within the college session.

The student takes the impressions; makes the models, and then we discuss the case in the presence of the patient. He brings to me, at his leisure, a drawing of the appliances he thinks would be suitable in that case, and also his diagnosis. I discuss that with him, and if I think it is right, I permit him to go on with the work. In many cases I allow the student to go on with a slightly defective design simply because he has

studied it out himself and I do not wish to interfere with original thought. I see the case as often as I can. The student writes up his case; makes plaster models and drawings of his appliances; fits appliances to the models, etc. These are indexed and laid away for future reference, and they are indexed in the catalogue. He can go to the index book in the library and find all the cases under that diagnosis. He can take them out and study them and thus arrive at some conclusion in his own case. If that boy leaves college without knowing something about orthodontia, there is something the matter with him. He does the work himself; does his own thinking; he makes his own appliances; draws his own conclusions; and is thrown, largely, on his own resources, except that he knows that we will not allow him to go wrong. Of course, the essential thing is to make the student think the whole thing out himself; he is put on his mettle; and he is laying a foundation that will prevent him from doing faulty dentistry later on.

Dr. J. B. Littig, New York City. This discussion has suggested something to me that I wish to speak about briefly. It is all very well for us to say that we ought to teach students along a certain line, but when our students have to go before a State Board and answer such questions as "Whose system is the best," what are we to do? We have to prepare them to answer such questions, even to knowing how to make the various kinds of appliances that they have to use. So that it is not only a question of what we would like to teach them, but also what we are obliged to teach them.

In our school we teach our students to understand all we can. We tell them the whys and wherefores; the etiology of the case, and what appliances should be used to correct it. We use lantern slides wherever we can. But I do not stop there. I say to them that under some circumstances they might correct the tooth that way, but that there is an easier way to do it, and, then, I point the easier and better way.

Then, I hold a clinic once a week in which I treat cases of irregularity. I call for student volunteers to treat each case. Those who do not care about orthodontia will not volunteer, whereas those who are interested always respond. So that they have plenty of cases and they get good instruction simply because they like the work; and they carry out, under my supervision, what they have learned. Of course, in the infirmary we cannot treat these cases as we can in the office. We have to try to get through with the case as soon as possible, because these patients soon get out of patience and they will stop coming before the work is completed. So I tell my students that if this case was a private case I would treat it otherwise, but that under the conditions existing in the infirmary we will have to treat the case as we do. And we always do the best we can for

each case. I always tell my students that if they intend making a specialty of orthodontia to go and see Dr. Angle for six months.

Dr. C. A. Hawley, Columbus, O. This is so vast a subject that I hardly know just what to say, yet several years of experience as a teacher have forced upon me some convictions. The work in the clinic has been very unsatisfactory, but, as the essayist said, this has been due largely to the fact that the teacher was incompetent. The fundamental principles of orthodontia must be taught; the existence of accurate methods must be shown the student; he must be shown how to make accurate models. And, it seems to me, that the place to teach accurate model making is in the prosthetic department during the first year.

I remember well my experience in taking plaster impressions of full dentures. If the method in vogue then is not the proper method for orthodentia cases, then, it is not the proper method in any case. The principles of occlusion should be taught and they should be understood and studied in their relations to crown and bridge work and to operative dentistry. This is a very necessary subject; the principles of occlusion in modern orthodontia are very valuable, indeed, to the man making crowns and bridges; and to the student in his junior year they are exceedingly valuable. He should not come to the course in orthodontia without a knowledge of occlusion.

There is one unfortunate thing that will happen if students have not some training in orthodontia technique. Only a small percentage of students begin to practice in a large city where there are specialists. Many of them go to small towns where these cases are plentiful and they must do something for their patients. Therefore, I believe that every student should be taught the principles of this work so that he will know something about it and have an idea what is to be done to give relief. The course should not be elective, nor should it be open to those only who have a special aptitude for the work. These cases in the small towns must be treated. Perhaps, they will not be treated perfectly, but the young men can commence upon them, and if successful he can devote a certain amount of his time, say one or two days a week, to orthodontia cases. Finally he may develop in that direction and devote himself altogether to orthodontia. It has always seemed to me that any one who wishes to take up the specialty of orthodontia ought first to have practiced several years in general work, because there are many things that will be of service to him. Training of his fingers would be essential. It is very difficult to determine just what should be taught and how it should be taught. That question can only be solved in the future.

Dr. G. V. Black, Chicago. I have had a great deal to do with orthodontia cases in my time. I have regulated many cases myself, and I have seen the results of work done by others, and I know that a condition confronts us and we must meet it the best we can. Every school must teach orthodontia, and to the whole class. I do not mean to say that we can make ideal orthodontists of each member of the class, because that is not expected. And you must not look at us, who are managing schools, as failures because we fail to make ideal orthodontists of each member of the class. There will be one here and there who is adapted to the work and he will develop into an orthodontist, but there will be a great number of these young men who will do the more simple things in orthodontia, as the cases come to them, and do them well. The man who goes through a medical school and starts out to practice in the country will do some things well enough to be a benefit to his community. In the more severe cases he will send for a specialist and not attempt to do them himself; and yet he will be a useful man in his neighborhood. Our men will go out and do likewise. Many of these people cannot go to a specialist because they cannot pay his bill, and the family dentist is compelled to do the work or lose the family.

Dr. Hoff. I thank you very much for the consideration you have given my paper. Dr. Black has said what I wanted to say in reply to Dr. Angle. We are compelled to teach this subject, and we want to teach it. We cannot afford to do without it. Orthodontia is a part of dentistry and not a separate profession.

According to a statement made here today this subject should be taught by specialists. Another statement says there are but twelve specialists in orthodontia in this country. There are fifty-one dental colleges. How are you going to harmonize these conditions?

The suggestion was made by Dr. Angle that he finds it troublesome to conduct a private school and that the colleges should do the work. To my knowledge he has refused to accept, during the last session of his school, men who are anxious to take up this work. A good man came several thousand miles last fall to enter his school and was refused. How are you specialists going to meet this educational question? If you do not approve of our methods of teaching you should tell us of better ones. That is why I brought my paper here to-day. I know our problems, and I know what we are trying to do. I also realize what we ought to do, and what is expected of us. The colleges are trying to meet all these demands as far as they can do so. I am glad I presented my paper to this body, because your criticisms will do me much good. Your suggestions with what I have seen and heard will stimulate me to work out this problem and I think I can do it, to a tolerably satisfactory degree, at least.

The Orthodontia of the Old School.

By Anna Hopkins, D.D.S., St. Louis, Mo.

For several years I have been much interested in models of cases of malocclusion that are sent in large numbers each year to Dr. Angle, together with letters asking advice in the matter of treatment, and it has occurred to me that it might be of interest and profit to you, members of the new school of orthodontia, to have a few of these brought to your attention for your discussion. They are of interest to us because they show how the old school of orthodontists regards the science, and of profit because they may open our eyes to some of our own shortcomings, and encourage us by their many imperfections to a greater effort to perfect our own work.

I wish in the beginning to say, however, that they are shown only in the kindliest spirit, and if they seem to suffer in comparison with the products of the orthodontists of the new school it is not that we would hold them or their makers up to ridicule, but that in seeing where they are wrong, we may know better what to avoid ourselves; that by their wrong methods we would be more clearly directed to the path of truth and right methods.

The new school recognizes in orthodontia a very high and a very arbitrary standard, but one not of its own making. It is, the teeth in normal occlusion, which is, as to arrangement, teeth in perfection—a very high standard indeed. (See Fig. 1).

We recognize that if for any reason, such as the extraction or non-eruption of any permanent tooth or teeth, we are unable to produce normal occlusion in treatment our result is not a complete success; that if we do not have normal occlusion we must have malocclusion to a greater or less degree.

That the orthodontists of the old school do not recognize any standard higher than the placing of teeth in "regular rows" their models and their words clearly testify, yet we know that all of the teeth of each arch may be regular as to alignment and yet every tooth be in malocclusion. They do not recognize occlusion—the basis of all dentistry—and they cannot, therefore, realize that a consideration of the facial lines of their patients is second only to that of the occlusion of their teeth; that the mouth is as essential as any other feature to the harmony and beauty of

the face, to its balance and proper proportion, nor that the mouth is oftener out of balance and out of harmony than any other feature; that the facial lines are marred just as often as malocclusion exists, and just in proportion as it exists, and that they often have it in their power to mould the mouth from lines of ugliness to those of beauty. If they did they would know that good photographs of at least the profiles of their patients' faces are as necessary to send for intelligent diagnosis of their cases as accurate models of their teeth, not quartering views which tend to disguise the deformities, nor of a plaster cast of the face, which can by no possible means be an accurate or sufficient basis for determining the extent of in-

harmony or lack of balance of the facial lines. We must study the face in relation to and as a part of the lines of the whole head, and to try to study them only in part from a cast of the face is like trying to study the malocclusion with a model of only the upper teeth. For intelligent study we must have a *full side view* of the patient's head, sharp and clear, showing everything even to the freckles on her nose, as in Fig. 2.

Again, if the orthodontists of the old school realized the absolutely essential character of occlusion and of facial lines, in other words, if they knew what the science of orthodontia really is and what its requirements

are, they could not be content to make slipshod models from inaccurate plastic or wax impressions, showing only the crowns of the teeth, as in Fig. 3, or parts of the crowns, as in Fig. 4. They would know that the alveolar process, being the most important tissue with which we have to deal, must be shown in the models as far up (in the upper) and as low down (in the lower) as the attachment of the muscles will permit, as in Fig. 5, and that they must also show not only the positions, relations and articulation of the tooth crowns, but the direction and inclination of their roots labially, bucally and lingually, as well as the occlusion from the lingual aspect.

FIG. 2

Another important matter that they of the old school entirely overlook, chiefly because they do not understand occlusion, is the value and importance of individul teeth. We know that ideal occlusion is forever lost the moment a single tooth is extracted. They do not hesitate to extract any tooth from a lateral incisor, bicuspid, or first molar, to all four first molars, or even to one first molar and six bicuspids, as shown in Fig. 6.

Their models would indicate that orthodontia has no scientific meaning to them; their letters would seem to indicate what it does mean—merely a

matter of appliances, and—fees. Here are extracts from a few of them that are typical of all. One says:

FIG. 3

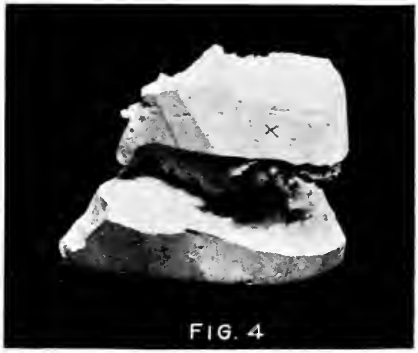


FIG. 4

Letters from Dentists Seeking Advice.

"I send you a model of a young lady's teeth. I am not sure that I know what to do and take the liberty to write to you for advice. The missing teeth (lateral incisor and first bicuspid) were extracted some two months ago." The case is shown in Fig.

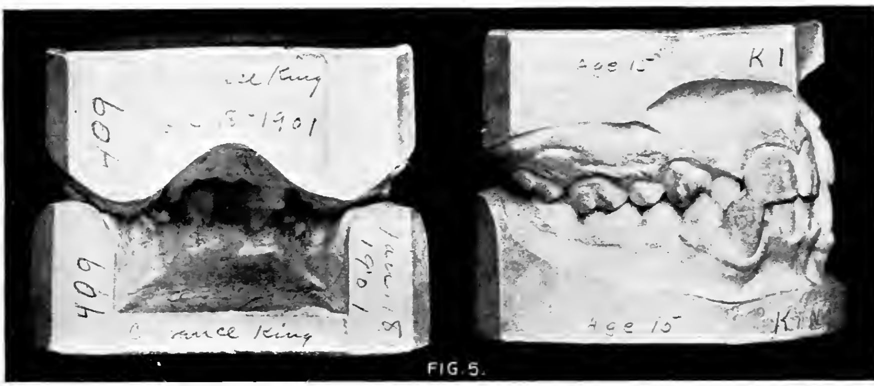


FIG. 5.

7. Could the writer have given more convincing evidence of his lack of knowledge of the very elements of orthodontia? And yet he hopes to

receive in one letter of advice sufficient instructions to enable him to successfully treat the case he has ruined at the very start.

Another writes: "I send you by this mail the models of two cases for regulation. The patients are sisters, fourteen and eighteen years old. The

FIG. 6

question with me is the best way to correct the difficulty. In the case with the protruding lower jaw will it not be best to use the head appliance to draw the jaw back? I would like to know the time it will take to correct and what appliances you would use, and the charges to make them." Both

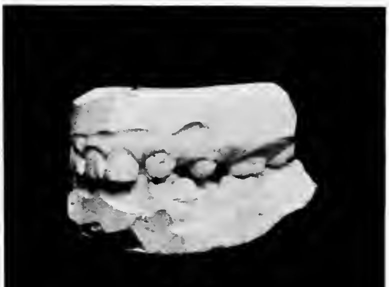


FIG. 7

these cases are shown in Fig. 8. Difficult cases, both, yet without a word concerning occlusion, no reference to the loss of a first lower molar in each case, no mention of facial lines; his questions refer only to "time required," "appliances," and "charges."

Another says: "By this mail I send you a case of orthodontia and would ask you to kindly give me your opinion and mode of procedure for regulating same, if practical, and a certain assurance of success. I am practically inexperienced in the line of orthodontia, having had only a few cases in my practice. . . . The patient is a girl of thirteen years, upper lip short. Notice that a bicuspid has been extracted on either side above (also on the right side below); molar (upper first) on left side decayed, broken down somewhat." The case is shown in Fig. 9. It would be something gained for humanity if colleges would only teach their students to keep "hands off" in cases where they acknowledge at least their "inexperience." Malocclusion, pure and simple, is bad enough, but when it is complicated by needless and inexcusable extraction by men who "ought to know" the condition becomes pitiable indeed.

Still another writes "I send you by today's mail models of a case of a

FIG. 8

young lady of my town who is very anxious to have her teeth regulated and wanted me to undertake it. Her case is extensive and complicated, and I do not feel competent to undertake to regulate her case, having had but little experience in this branch of dentistry; hence I send models to you and ask your advice in her behalf. The young lady is twenty-two years old. . . . How long would it take to regulate her case and what should I charge her?" This case is shown in Fig. 10. The case is indeed "extensive and complicated;" too extensive and too complicated to be undertaken by one of little experience and less real knowledge and appreciation of the true condition and what is necessary to restore the case to normal occlusion.

And finally we have the following: "I wish for advice in a case I wish to get a regulating appliance made for. For cut nearest like case see Harris's Practice, tenth edition, by Gorgas, page 415, Fig. 195, right central

sitting in more edgewise than in figure, if any difference. The lady is about twenty-five years old. It will not be convenient for me to see her often after the appliance is adjusted in the mouth. I would like it made in such a way that it might be easily adjusted to other cases hereafter, provided it can be done as well. How long a time do you think will be necessary to complete such a case? Please give me the cost and I will send models. Would like it as cheap as it can be done to fill all requirements."

The Old School Criticised.

These are examples of hundreds of letters and models sent yearly for advice on this subject—letters and models that expose not only a surprising lack of knowledge of true orthodontia, but a more surprising ignorance of this lack of knowledge. No honest man with a scientific knowledge and understanding of real orthodontia would extract seven teeth or even one tooth, from a full set of teeth in a case he was treating, as has

FIG. 9

FIG. 10

been done in cases illustrated. No honest man would undertake to treat a tooth or fill a tooth or crown a tooth if he had not first made a special study of the subject and had had experience previously under instructors, yet we find them here wishing to undertake the most difficult cases in the most difficult branch of dentistry, while displaying a woful lack of special knowledge, and admitting their inexperience. We do not doubt their honesty. We know they are doing just what they were taught to do in dental colleges. In all dental subjects except orthodontia they probably had careful teaching and practical experience, but they were taught that orthodontia was an unclassified, chaotic muddle of crooked teeth, "beginning nowhere and ending nowhere," and many of them doubtless never saw a case of malocclusion even incorrectly treated.

And we will have an "old school" that will go on treating malocclusion in this way and extracting sound, beautiful teeth at random, not only not knowing they are working irreparable injury to their patients, but be-

lieving they are benefiting them, just as long as we have dental colleges that teach orthodontia in this slipshod unmethodical way. And as long as men accept these teachings, orthodontia will not and cannot progress, for they are not orthodontia. They are something—nothing; worse than nothing. Orthodontia is a science—a definite science, founded on a natural law. In treatment it has a definite aim, pursued in a logical manner by definite means, and if the aim is accomplished the result is a success. If it is not, the result is not a success. This aim is to place *all* of the teeth in normal occlusion and the result, if this be accomplished, is to place the teeth and the muscles of the mouth in a position and condition to perform their normal functions—their functions normally; to give to the face its normal contour; and to aid in the restoration of normal respiration, which is usually disturbed in cases of malocclusion, especially in cases belonging to Classes II. and III.

This is the true orthodontia—the orthodontia in which the "new school" believes. And this orthodontia will benefit humanity, not mutilate and deform it; and it will benefit its practitioners, for it is far more ennobling to build a beautiful structure than to tear it down or injure it.

Discussion.

Dr. N. S. Hoff, Ann Arbor, Mich.

To old teachers like Dr. Guilford and myself the matter presented in this paper is not new, although it may be to some of you. I have been getting just such models for many years; and some of them much worse than those Dr. Hopkins has shown us. The question is what shall we do about it. I have always been very charitable in this matter; and whenever I get such a model I send it back and ask for a better one before I will give any advice. I always give my correspondent to understand the importance of having good models in cases of this kind. Possibly you may feel that it is beneath your dignity to take notice of such things, but these models come from people who are in earnest. You might say that they do not know any better, and that is the truth; but they are in earnest, and if we are to do our whole duty we must explain matters to them and teach them how to do better. Mr. Elbert Hubbard has said that no man is educated until he is dead. Most of us are learning something all the time, and these people must be educated all the time. Why should we not avail ourselves of the opportunity to do something for these unfortunate patients through their dentists. We cannot tell what may be the result of a little time and labor spent in starting them in the right way. It may result in bringing into the fold of the orthodontists a man of whom we shall be proud in the future. It is my custom generally to answer these men to the best of my ability.

Of course, I do not give them the details as to how I would do the work, but I give them advice on how to do their patients some good, calling their attention to the literature on the subject, and giving them suggestions which will put them on the right track. I do not make appliances for them but sometimes outline the treatment after giving a diagnosis. Those who appreciate the value of good models know that it is impossible to do good work, or intelligent work without them; and if we can impress this fact on these men we are doing work of which we may well be proud. I suppose that Dr. Angle gets so many inquiries of this sort that he becomes weary of it, especially when the models are very bad and the data insufficient. Here is where we can do something to develop this specialty in the proper way, and we ought to do it, as it will certainly bring large returns, not perhaps in fees, but in a broader culture and new interest in the subject. Would it not be a good piece of work for this organization to take up the dissemination of suitable literature on the subject of impression and model making? There is hardly one man in five hundred who appreciates the value of good models or knows how to secure them. Let us raise a committee to write a tract which we can send to every dentist in the country, or write it up, or demonstrate it in every local society, so as to get it in the journals.

Dr. H. A. Pullen, Buffalo, N. Y.

I enjoyed this paper very much indeed, especially because it comes from one of our lady orthodontists. Dr. Hoff's statements are true, but, personally, I have had but little success follow my efforts in the direction he mentioned. I had been conducting a sort of correspondence school, but I find that the correspondence usually ends with my answer to the first letter I receive. Probably this is because I point out so many difficulties in the case that the dentist does not care to undertake it. Certainly, I would not care to continue the correspondence for a year or two, telling him just how to do it. That is neither a good nor feasible plan of education.

Dr. A. E. Webster, Toronto, Can.

I receive three or four such models every week, but in no one case do I refuse to give all the information I have on the matter, and I give the very best advice I can. Of course, I usually refer them to some text book, and as I have a faculty of remembering where I have read some article bearing more particularly on the case, I refer the man to that. I refer him to everything within his reach. I do not instruct him to go ahead with the case unless I am convinced that he can do the work. In most cases it is better to advise him to let it go and take an easier case.

Dr. Young.

We have had two men who are connected with colleges tell us that they often get such models as

these. Evidently these models come from men who have graduated from the schools which these gentlemen represent. That must mean that the colleges are not doing their duty in the teaching of this work or their graduates would know better how to take a good impression, and make a perfect model.

Dr. F. M. Casto, Columbus, O.

Speaking of poor models, I do not believe it is always a case of inability on the part of the dentist to make models. Most of them could make better models if they thought it necessary. Nor do they appreciate the value of good models in this work. All they try to do is to get an impression of the crowns of the teeth, deeming that to be all that is necessary. If, as has been pointed out, they could understand the necessity and importance of facial lines, and all else that is necessary for us to know in our work, I am sure that they would send us better models when asking for advice.

A Classification of the Principles and Forces of Retention.

By Dr. M. Dewey, Keokuk, Iowa.

No one thing has done more toward advancing science than has classification. Wherever we have found classification of knowledge, we have seen advancement; where we have found system and order we have observed success; where lack of arrangement, we have found failure.

Importance of Classification.

No one thing has contributed more toward placing orthodontia where it is today than has that one thing, classification. Not only have causes of malocclusion and regulating appliances been arranged in order, but individual cases of malocclusion have also been classified so as to enable us to speak of them with a certain amount of comprehension not known in former times.

Anchorage has been arranged and classified so that each term denotes some idea to those who have given it study. It was to an extent due to a certain form of anchorage that the practice of orthodontia has been revolutionized—I refer to the "Baker anchorage."

When we reach retention we find no such classification as has been applied to the other departments of this subject. It has been ignored in part and left to take care of itself. Much has been said in the past in regard to regulating appliances and treatment, but little has been mentioned about retention. I consider retention of equal importance with tooth movement in the correction of malocclusion, for if we fail to retain the teeth in

their corrected position, what have we gained? Many results of cases reported in the journals indicate the condition immediately after the appliances for tooth movement have been removed. But very few show the ultimate result, and I am afraid that in many cases the results were not as favorable in after years when they should in reality have been better than they were immediately after the removal of the retainers.

My attention, as a teacher, was called to this lack of classification for I found it far more difficult to impart as good an understanding of retention as of the preceding subjects. Therefore after much thought I concluded that retention might be classified as well as had the forces of occlusion, etiology of malocclusion and anchorage.

Retention Defined. Retention may be defined as an applied force to maintain certain relations between certain objects. Under this definition might be placed the retaining fee paid to the operator by the patient to maintain certain fixed relations as to temperament, character and time of appointments. Retention in orthodontia is force applied to teeth in order to hold them in certain relations to one another.

These forces of retention are of two kinds, viz.: natural and mechanical.

The natural forces are those exerted by natural laws. They are by far the most important, yet they have been the most ignored and misunderstood in the past and consequently innumerable failures have resulted. Teeth returning to their former position, and sometimes even to worse positions than they occupied first, may in most instances credit their return trip to a neglect on the part of the operator to reckon with the natural forces of retention. Many cases of malocclusion are simply the result of a disturbance of or tampering with Nature's laws and no matter how well you may have seemingly corrected such malocclusion, if you have failed to enlist the natural forces of retention, you can never hope for success in the fullest degree.

These natural forces are as follows:

1. Normal muscular pressure.
2. Harmony in the sizes of the arches.
3. Forces of the inclined planes.
4. Normal interproximal contact.
5. Normal alveolar process and peridental membrane.

In normal muscular pressure we have the symmetrical and harmonious force exerted by the tongue, lips and cheeks. If these act normally, not only are the teeth held in their positions but the sizes of the arches are also maintained, resulting in a well-balanced face. On the other hand if this force acts abnormally, it forms one of the most potent

causes of malocclusion and mars the facial lines. It then follows that if we desire to correct a case of malocclusion in which abnormal muscular pressure is an etiologic factor, this disturbing element must be corrected unless the old story of teeth "going back in spite of prolonged mechanical retention" should again disturb our peace of mind.

Harmony in the sizes of the arches expresses the relation which one arch bears to the other. There is always a certain degree of force exerted by one arch upon the other during the entire life of the individual. If one arch be too large or too small, having been made so voluntarily or involuntarily, a compensating abnormality will be found in the opposing arch. Therefore, no matter how nicely the teeth may be arranged in their respective arches, unless the opposing arches harmonize with one another no permanent success can be expected because this natural retentive force has not been established.

Inclined Planes. So much has been said in recent years of the inclined planes that it is needless for me to give any lengthy comment on these as a natural force of retention. It is a force ever present during mastication as well as when the teeth are at rest. While it is a great force for good, it is equally as great in producing so-called harm when applied incorrectly. If these inclined planes come in proper contact every time force is brought to bear on the cusps, their influence will tend to retain the teeth in their position. No inclined plane is so small or so insignificant that we can afford to overlook it in our work. It is the force not comprehended at all by men who advocate extraction for the prevention and correction of malocclusion.

Interproximal Contact. The next natural force, viz.: the normal interproximal contact is of equally great importance as those before mentioned. It has scarcely been spoken of in the past, probably because writers have failed to recognize its independence from the force of the inclined planes. By the force of interproximal contact is meant the force one tooth in an arch exerts upon its approximating teeth. This force is passive to a certain extent. It may be illustrated by the blocks of stone in an arch of masonry. The contact point being only a point on a nearly round surface, is to a great extent like the point of contact between two spheres. If force is brought to bear from one to the other, directly parallel in line with their diameters they will remain stationary, but if applied at different angles, they will roll. If once the interproximal contact points of the teeth are moved out of line, the teeth tend to move further. Often we see cuspids and premolars in torsal occlusion when really the inclined planes are not out of harmony, but, because the contact points are not in proper relation, the teeth slip on one another to a certain extent. In cases of extraction the teeth move in the

arch because they have lost their normal approximal contact, yet the relations of the inclined planes are not always disturbed. The tendency of the lower cuspids to return to old positions of torsal occlusion can be explained in this way. It is impossible for me to see how any one who is familiar with these forces can advocate extraction and expect to get even a fair result. In all cases of extraction one or more of the natural forces of retention are disturbed.

Influence of Alveolar Process.

The force derived from a normal peridental membrane and alveolar process is of much importance and must be studied during the entire treatment of a case. We must be familiar with its structure from an histological and physiological standpoint so that no permanent harm may be done during treatment. In cases of malocclusion caused by diseased peridental membrane and alveolar process, no matter how long the teeth may be retained, if the physiological conditions have not been established the case is one for permanent mechanical retention.

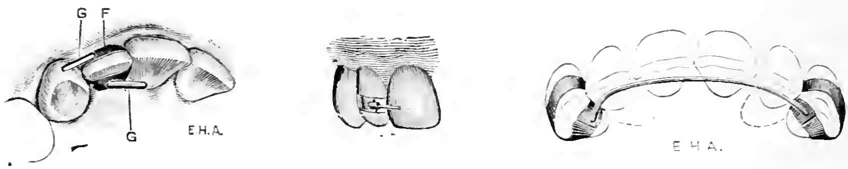


Fig. 1—Simple Retention.

Mechanical Forces.

Mechanical forces are those exerted by artificial means. They should only be employed in a manner to assist the natural forces. While mechanical forces must be used, they are but second in importance. I have classified these as simple retention, reciprocal retention, occlusal retention, occipital retention; occlusal and occipital forces of retention having subdivisions.

Simple retention is obtained, Fig. 1, by attaching a tooth which has been moved to one which is already solid in the arch, in order to get sufficient force to hold the moved tooth until the natural forces can be established. In applying force in retention, it should be "applied in the direction of the backward tendency."

Reciprocal retention is the pitting of the backward force of one tooth against another having a tendency to move in an opposite direction. In this we have two divisions, viz.: simple and compound.

Simple reciprocal retention, Fig. 2, is applicable in cases in which the backward tendency of one tooth is pitted directly against the backward tendency of another. Take for example a case in which the incisors have

been rotated in opposite directions and one tooth retains the other by means of retaining devices so attached.

Compound reciprocal retention, Fig. 3, is indicated whenever certain teeth are retained by force exerted from some other teeth which have a tendency to move in different directions. In this form of retention other teeth than those to which the retaining appliance is attached are also being retained. Although some portions of the device may rest against the teeth yet it is not rigidly attached. For example of this class I would cite cases in which the six anterior teeth are being retained when bands are only placed on two of the teeth. By careful study of this division of re-

Fig. 2—Simple Reciprocal Retention.

Fig. 3—Compound Reciprocal Retention.

tention we will be enabled to eliminate a large amount of unnecessary bulk in the form of bands and spurs for the benefit of our patients and still preserve our work.

In occlusal retention the force of the teeth in one arch is pitted against the force of the teeth in the other arch. Of this class we again have two divisions, viz.: simple and stationary.

In simple occlusal retention, Fig. 4, the backward tendency of the teeth in one arch is pitted against the other. The appliance is so attached that the teeth may tip to a certain extent. While this plan is very useful, it always requires watching.

In stationary occlusal retention, Fig. 5, the appliance is attached to the teeth in a manner compelling them to move bodily if they move at all.

These forms of occlusal retention are employed when the mesio-distal relations of the arches has been changed. In the construction of stationary occlusal retention the same plan is followed as in the construction of

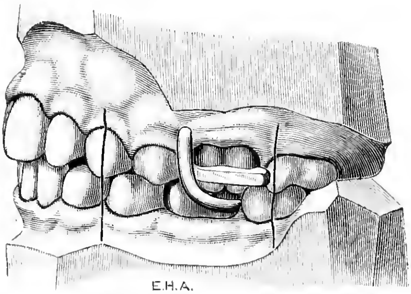


Fig. 4.

stationary anchorage. The appliance is so placed and fitted to the teeth in one arch that when the force is brought to bear from the opposing arch the teeth are held rigidly and no movement is possible except to move them bodily through the process. While this device occupies more space in the oral cavity than the simple occlusal retainer, it will be found to be of an advantage in retaining cases of "Class II." treated by moving the man-

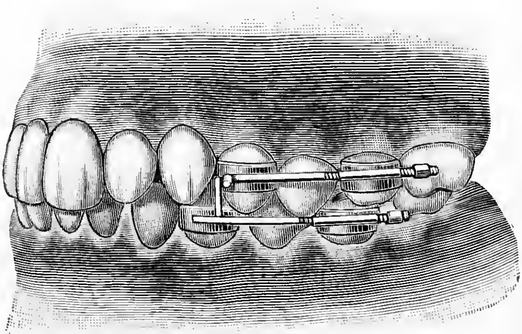


Fig. 5.

dible forward. The disadvantage, in the past, to this plan of treatment has been the difficulty of retention which is overcome to a great extent by stationary occlusal retention. The success to be had from the use of this plan of retention will depend upon the rigidity which the manner of its construction will afford.

In occipital retention the force is obtained from attachment made to the occipital portion of the head. It is too old a method to need our attention at this time.

Mechanical retaining devices are of two kinds, namely, removable and fixed. Removable appliances are those which the patient can remove from the mouth at will. Fixed appliances are those attached to the teeth in a manner preventing removal by the patient. Each kind has certain advantages not possessed by the other.

My object in presenting this paper was to render retention more easy of comprehension since it is one of the most important subjects in the treatment of malocclusion.

Report of Two Cases in Orthodontia.

By A. H. Ketcham, D.D.S., Denver, Col.

In compliance with Dr. Angle's request to his former students, I will endeavor to give a report of two of my cases, one of which, I believe, is a failure, measured by modern art standards.

They are two badly mutilated Class 1 cases. Treatment was begun on both at about the same time.

In the first case, Figure 1, the right upper molar was lost at eight years of age, the left at about fourteen years, and after a futile attempt at regulating, the right upper lateral was also extracted. The lack of development of the alveolus in the region of the cuspids and incisors is pronounced, especially in the upper.

In Figure 2, the upper lip is short and lacks fulness. Figure 3 shows improvement in the upper lip, as it is now longer and curves outward in harmony with the curves of nose, chin and forehead.

This was brought about by placing each tooth in its proper occlusal position, Figure 4. The lost teeth were replaced by artificial substitutes on the retaining plate.

In the second case, Figure 5, the upper first and second molars and right second bicuspids are missing, as are also the lower cuspids.

The remaining teeth were affected with pyorrhea alveolaris, which entirely disappeared after receiving the proper treatment.

The next consideration was the method of treatment to improve the occlusion; the upper arch was narrow coming to an angle at mesial corner of central incisors and depressed lingually in region of bicuspids, the

mouth having a high narrow roof, sometimes described as a V or saddle arch by the old writers.

The lower arch was constricted, the crowns of all the teeth slanting

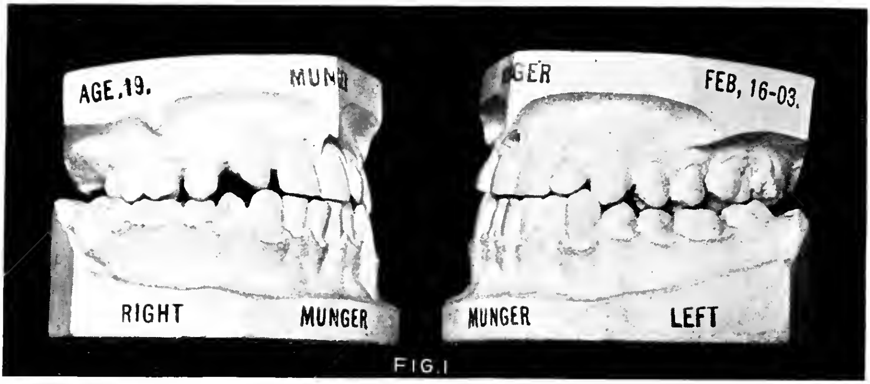


FIG.1

FIG.2.

FIG.3

lingually, with the exception of the cuspids, which had been extracted because they were outside of the line formed by the incisors and bicuspids.

The face is long and appears narrow, which is accounted for by the lack of development of the arches. Looking at the full face it is seen that the crowns of the central incisors are not covered by the upper lip.

In the treatment of this case (Fig. 5), I was obliged to take into consideration the physical condition of the patient, as he came to Colorado in search of health and even a slight disturbance to his nutrition might cause a return of the old trouble.

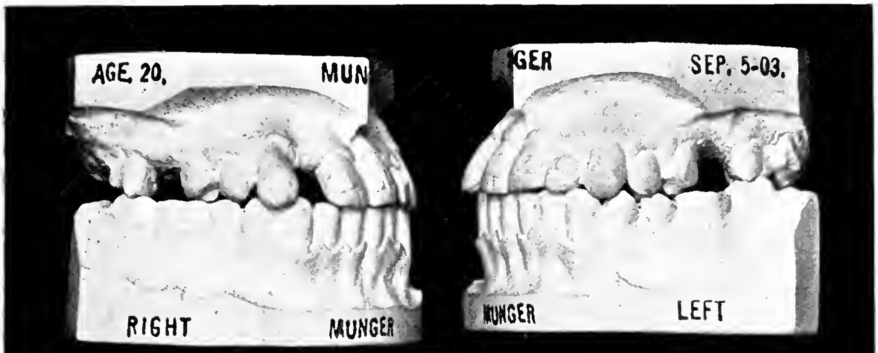


FIG. 4

FIG. 5

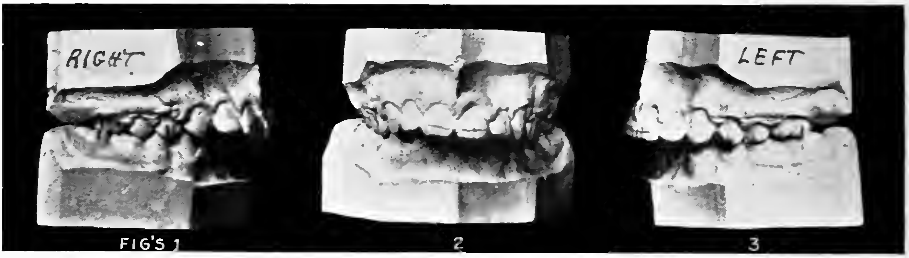
FIG. 6

After explaining the proper course of procedure, viz., expansion of both arches and replacing lost teeth, with the consequent improvement in the contour of the face, and the shorter method of moving back the pro-

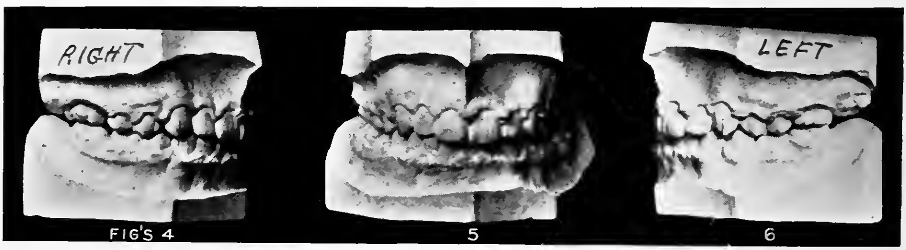
truding upper incisors without correcting the lower arch, finding the patient strongly against the first method, I decided to follow the second course. I removed the crowns, which supported a bridge, from left upper third molar and second bicuspid (I afterward removed the second bicuspid with my fingers, and placed D bands on the third molars, and expansion arch in place). I moved the first bicuspids and cuspids distally to their normal position, the width of one tooth, and by means of Baker anchorage moved the incisors back, Fig. 6.

The incisors are retained by a piece of G wire resting on their labial surface with the ends passing between laterals and cuspids and vulcanized into the retaining plate, which carries teeth replacing lost molars and bicuspids.

The teeth seem quite firm in their new position now. (Nov. 30th.)



FIG'S 1 2 3



FIG'S 4 5 6

Report of Cases.

By Dr. F. C. Kemple, of Erie, Pa.

The two cases which I wish to report to the Society are interesting to me because they both belong to Class No. 2, Division 1 (Angle Classification), and neither of them, so far as I am able to learn, has ever been associated with mouth breathing.

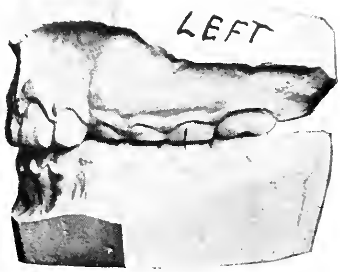
The first case—Figures 1, 2, and 3—a boy, age 14 years, physically well developed, gave no history whatever of mouth breathing.

The father and paternal grandfather were afflicted with malocclusion of the same class; other members of the father's family showing a tendency toward the same malformation.

Figures 4, 5 and 6 show the case immediately after the regulating appliances were removed.

The second case—Figures 7 and 8—boy, age 9 years; perfectly strong

FIG'S 7 8



FIG'S 9 10

and healthy, no history of mouth breathing, but an habitual thumb sucker from infancy. He was still possessed of this habit when presented for treatment.

Figures 9 and 10 show the completed case.

Neither case is peculiar in any respect except in the non-association with mouth breathing.

Report of Cases.

By Dr. Norman G. Reoch, Boston, Mass.

I have pleasure in presenting for your consideration two cases which present some points of interest. I will describe them very briefly with the aid of photographs.

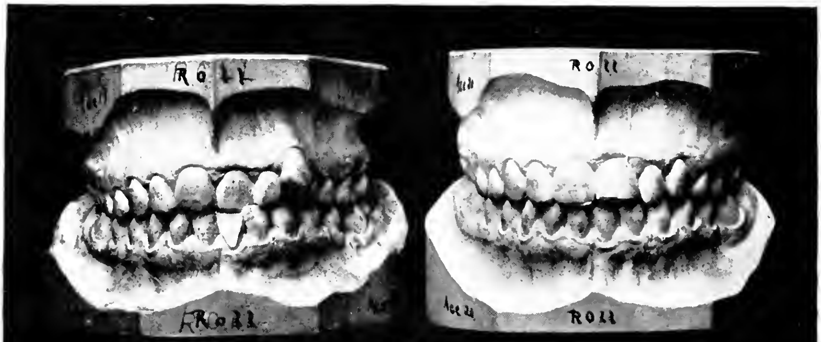


FIG. 1

FIG. 2.

The first case is that of a young lady, 19 years of age. She had suffered by the loss of three of the first molars. This case falls under Class II., subdivision of Division II. No attempt was made to remedy the distal occlusion of the left side. In regulating I simply sought for an "improved occlusion." Figure 1 shows the front view of models before and after treatment. The model to the left shows the malocclusion of the an-

terior teeth. The upper left central incisor is in lingual occlusion, and the lateral slightly so. The upper left cuspid is in pronounced labial occlusion, greatly marring the facial expression.

This case was already horribly mutilated by extraction. So I deemed it best, under the circumstances, to sacrifice the upper left first premolar to accomplish the desired results. The retraction of the cuspid was effected by the distal spring of the arch, that is, the tendency of the arch to slide

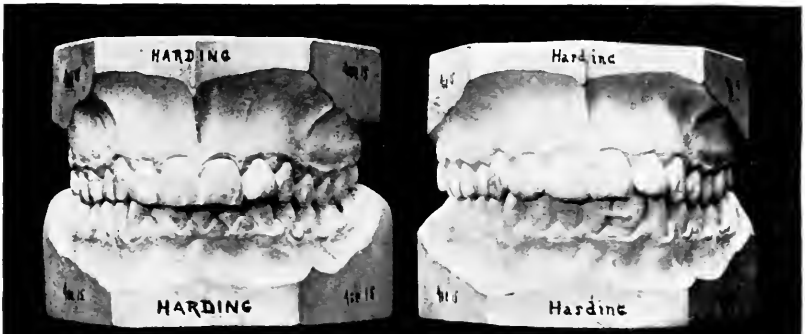


FIG.3


FIG.4.

distally through the tubes of the anchor teeth when properly bent. This force was assisted by the ligation to the arch of the two incisors in lingual occlusion. Rubber wedges were constantly kept between the arch and the cuspid tooth. The cuspid was retracted easily by this means, but not as rapidly as it might have been done had the traction screw been employed. The relation of the molars was not disturbed as sometimes occurs in the latter method.

Figure 2 shows a side view of the models. The cuspid was retained

by ligating with a brass wire ligature to the second premolar. The occlusion was sufficient for the retention of the central and lateral incisors.

Figure 3 shows front view of models of a case in Class I. This case called for expansion in the cuspid region in the upper and lower arches—rotation of upper laterals—and rotation and labial movement of lower incisor. The necessary movements were effected by the usual appliances e. g.—anchor bands, arches, wire ligatures, and spurred bands.

Figure 4 shows a side view of the models. It will be noticed in this

FIG. 5.

picture how the labial movement of the lower incisors has opened the bite—or brought the line of occlusion where it belongs.

Figure 5 shows the occlusal aspect of the case.

The appearance of the upper left lateral in Figure 3 (completed case) suggests the thought that it is in labial occlusion. I will say that this is more apparent than real, as may be seen by comparing with the other pictures; there is not the sharp, well-defined mesio-incisal angle present in either of the upper laterals, but they are rounded and characterless.

I regret exceedingly that I have not the picture of the faces to show in these cases.

The Importance of Specialization.

By Mr. Elbert Hubbard, East Aurora, N. Y.

Some months ago I visited the city of Cremona, in Italy. The name and fame of Cremona are deathless because of one man who lived there about two hundred years ago. That man was Stradivarius. In his youth, when only sixteen years of age, Stradivarius was apprenticed to a man who made musical instruments. The name of that man was Amati. He made violins and harps. He made instruments to order; two strings, four, six, a dozen, a hundred. People at that time had an idea that the more strings a harp had the better it was. The more strings you had to play upon, the more music you could make. Fallacy! You can play on only a certain number of strings. We hear of harps having a thousand strings and the men who made them thought that a harp with a thousand strings would produce better music than one with four strings.

Stradivarius.

It was left to Stradivarius to discover that a violin should have four strings, and no more. That a violin should be just so long, and that it could not be extended two inches without losing in tone, quality, in value, in service, in beauty, in music. A violin must have a bridge just so high; a back of maple or hard wood; the front of soft wood. It should weigh so much, and no more. He began making violins when he was only sixteen years old; he did not make a violin that pleased him until he was fifty-six. For forty years he worked to produce a perfect violin; and he made a perfect violin two hundred years ago. And there has never been a better violin made since his day.

You all know that the piano is an imperfect musical instrument. Constant improvements and changes are being made in pianos, but there will never be a better violin made than that made by Stradivarius. And yet every Stradivarius violin is different. No two violins are alike. Where a man works in liberty and freedom, and thinks a thing out with his head, and makes it with his hands, he never duplicates. God never duplicates, and God works through us. I am the instrument of God.

Stradivarius had two pupils. He had many pupils; but he had two, in particular, who lent luster to his name as a teacher. These two were the Guarnieri brothers. And Joseph made violins as good as the master, but they were different violins. And when you visit the cathedral at Cremona, the janitor will take you up into the belfry and show you where Stradivarius stored the wood that absorbed the sweet sounds of sacred bells calling men to prayer. You will see the cathedral where Stradivarius

played his violin. He thought that cathedrals were built to test violins. He said that hell is the place where bad fiddlers go.

And so he tested his violins in the cathedral. And he used to have his young men go there and play the violin. They played high up in the belfry, and monks and bishops were there. They were very gentle with this man, and said "he is not just right in his mind. He thinks he makes violins to the glory of God."

It is a beautiful idea that we work for the glory of God. The individual who does a thing as well as he can, puts his heart and soul into his work, does this work for the glory of God. It is sacred work. But the monks did not reason as far as that, and did not understand that this man's work was eminently religious. But they tolerated him because he made beautiful musical instruments and played them in their cathedral.

Guarnieri.

And his boys would play while he stood behind some pillar and listened. One day, after he had completed a violin, this young man, Joseph Guarnieri, played the violin and the old man listened. And he said, "That is not my violin." He knew his children. He loved those violins, and every beautiful thing and every great thing is loved. You must put life into your work. Tolstoi said that there are those who think that you can deal with life without love; but you cannot do it.

Stradivarius knew that was not his violin. The boys were playing a joke on him. The tears ran down his old face as he said, "That is not my violin, but it is as good a violin as I can make. It is made by one of my boys." And it was made by Joseph Guarnieri, and, to-day, Stradivarius has only one rival, and that is Joseph Guarnieri.

Paginini.

Paginini, the greatest violinist the world ever saw, played a violin until the women who loved him gave him a Joseph Guarnieri. He played this violin for forty years on the concert stage. The violin is the only perfect musical instrument. It sympathizes with every throb of the heart; expresses your every thought, your desires, your aspirations, your hopes, your fears, and voices them. The violin is an extension of human speech. It voices the thoughts that are beyond speech.

For forty years Paginini played that one violin. Some of you may have been to Genoa and there in the town hall you may remember seeing this violin in its sealed up case. No bow has been drawn across it since the hand of Paginini has been stilled in death; and no one ever heard Paginini play except on the concert stage. A beggar boy, he played first in the streets, and finally he played in all the best theatres in Europe. He had no competitor. He could do with the violin what no one else has or can do. People said that this man had sold his soul to the devil. As if the

devil were stronger than God. One reason why they believed this was that he used to disappear from the world. He would stay away for three months or more, and no one ever knew where he had gone. Suddenly he would come back, and he would amaze the people by the music that he would bring out of that little violin. They said that he sold his soul to the devil, and it is only recently that his secret was given to the world.

A monk died recently at the St. Bernard's monastery, a man of ninety-four years of age. On his death bed he told this: "I knew Paginini. He used to come here to this monastery, and he would stay a month, two, three, a year. He lived in a stone cell right down below, and wore horse-hair robes. What did he do? He prayed and he worked and worked. The secret of his success was that he worked day after day; hour after hour; clear into the night. He practiced. This one thing he did. He practiced."

Stradivarius succeeded in making a perfect violin because he worked; he worked. This one thing he did. He worked. Paginini succeeded because he worked. If you succeed, and if I succeed, it is because we concentrate.

We all have about the same amount of capital. It depends upon how we use it. You are heirs to a certain amount of energy. What will you do with it? Spread it out thin so that it will cover a great deal of territory? Do a thousand things? Better not do anything at all. Concentrate! The man who succeeds in a masterly way, and helps this old world along in her course, is the man who concentrates.

Now, I do not know anything about your specialty, and, I presume, that you do. But you do not know all about it. You are learning more about it all the time; you are just in school. You will never reach the ideal stage. But, I congratulate you that you are in the suburbs. You come together to tell each other what you know, and you hold yourselves up to a certain standard. You pool your knowledge, and everyone takes away all he can hold and no more. Perhaps, some do not take away anything at all except what they bring. The reader of each paper told you a few things that you knew, but perhaps, you did not know you knew them until he told you. That is the way with many of us.

But this one thing you do, and if you will work, and work, and put your very life and soul into your work, you are bound to succeed, as did Stradivarius, as did Guarnieri; as did Paginini.

Education should not be a preparation for life. Education should be life, and life should be education, and you will never finish your education while you are on earth. You are in the kindergarten of God. Colleges only supply you with a few principles. Colleges never educated any man. You cannot get an education in four years, especially when you are sep-

arated from life. Knowledge supplies opportunities, and life supplies opportunities, and if you succeed in a masterly way, it is because you concentrated your energy upon this one thing. Like Stradivarius and Paginini, say "this one thing I do."

In closing, let me give you one thought. Robert Louis Stevenson said, "I know what pleasure is for I have done good work."

A Study of Occlusal Relations in Cleft Palate Cases.

By Rodrigues Ottolengui, M.D.S., New York.

Some years ago, when Dr. Brophy was first advocating his operation of forcibly closing the cleft maxillae as an operative cure for cleft palate, Dr. Norman W. Kingsly prophesied that such procedure would result in malocclusion because of the contracting of the upper arch. With great patience Dr. Brophy made no reply for years, until some of his patients had lived to attain second dentition. Finding the teeth in good occlusion, he announced the happy result and so finally removed the objection which had been made to his mode of treatment.

Subsequently, in a paper read before the Odontological Society in New York, he went further, and began to explain why it was that his violent compression of the jaws did not interfere with occlusion. He then advanced the theory that the cleft palate is something more than a mere slit in the roof of the mouth; that it is, in effect, a separation of the maxillary bones beyond their normal positions, and therefore that his forcible closure of the cleft really restores the maxillae to their true position. In establishing this idea he further declared that in such cases it would be found that the upper jaw is wider than the lower by just the dimensions of the cleft.

I had the pleasure of hearing both of Dr. Brophy's papers, the one in 1899 before the National and the other before the Odontological. The first paper left me satisfied that his operation does not necessarily interfere with the subsequent occlusion of the teeth, but the second paper left me unconvinced as to the reasons. In short I doubted the truth of the assertion that the upper jaw in cleft palate cases is spread apart and is wider than the lower by the width of the cleft.

It seemed to me that were this true, we should more frequently observe malocclusion in the molar region in mouths where no surgical in-

terference had occurred. At the time I had no definite knowledge on this point; I had made no collection of data, but the general impression made by the many cases which I had previously seen was that malocclusion peculiar to this abnormality was confined to the intermaxillary region.

At the 1899 meeting of the National Association Dr. Cryer also read a paper, and having heard Dr. Brophy's paper he touched upon this point and introduced one or two slides in evidence. He there advanced, what was, I think, a new idea in relation to the etiology of cleft palate. As he has since then embodied the same view in his work on "Internal Anatomy of the Face," I may quote from the last chapter therein (Page 164-5.)

Etiology of Cleft Palate.

"The normal position of the fœtus in utero is such that the weight of the entire fœtal body may readily be thrown upon the vertex and the pressure thus exerted would tend to force the mandible into contact with the sternal region and compress the forming jaws. The relatively advanced development of the mandible, as compared with that of the forming maxillae would under the circumstances referred to—and especially in cases of low nutritional standard—interfere with the normal closure of the brachial arches and tend to produce a permanent coloboma."

In the next paragraph he tells us, in effect, that in cases of cleft plate the upper jaw is as large as or larger than the lower, whilst normally it is smaller. In support of this last statement he introduces a figure, showing a section through the orbits, nasal chamber and molar teeth, in a skull from a fully developed fœtus, and this figure shows the molars of the lower jaw lying entirely external to those in the upper. To explain the subsequent occlusion of these teeth, where as we know the upper will overlap the lower, he states that in development the lower teeth incline inwardly, while the upper teeth incline outwardly.

Dr. Cryer, in the paragraph cited, simply says that the pressure of the jaws together would "interfere with the normal closure of the brachial arches;" he does not specifically tell us just what this interference is. But Dr. Brophy has adopted this view, advanced by Cryer, that cleft palate is due to compression of the mandible against the maxillae during fœtal life, and he has explained (at least to me), that the mandible rests within the upper arches, the compression forcing them apart. If this is the mode of interference suggested by Dr. Cryer it is difficult to make it meet the other proposition that the upper jaw is smaller than the lower. This being true, as indicated in Dr. Cryer's section, and the mandible being more developed that the maxillae in the conditions presupposed, it would seem to me logical to suppose that this would prevent the very mishap which it is said by Dr. Brophy to cause. The lower jaw being

larger than the upper, if pressed against it should engage it and prevent rather than cause its spreading.

Dr. Brophy has recently exhibited to me the casts of a mouth of an infant in which the lower jaw rests entirely within the upper arches, which are entirely cleft, and this he states is abnormal. He says that in the mouth of the normal infant, at birth the upper jaw is not larger than the lower. This is in accord with Dr. Cryer's declaration, that in edentulous arches, both in the fœtus prior to the appearance of teeth, and in the adult after the loss of teeth and resorption of the alveoli, the upper jaw is normally smaller than the lower. I shall not undertake to dispute Dr. Cryer's statement, as I have made no study of fœtal conditions. He must know what he writes to be true, and therefore I cannot oppose his argument. But Dr. Brophy's operation is not upon the fœtus, but upon the infant, and while the infant has edentulous jaws, we must not forget that in advance of the actual eruption of the teeth, there is present a well defined alveolar ridge. Of course the models shown me by Dr. Brophy were from the living subject, and therefore, in analogous argument, are to be compared with the infant mouth rather than with fœtal conditions. This particular point has come to my attention so very recently that I have had no opportunity to examine any number of newly born infants, but it is a curious fact that I have within a few days had the chance to examine two babies, within three days of their birth, and in both cases I found well defined alveolar ridges, the lower in each case closing entirely within the upper. Yet both are normal infants with apparently perfect profiles. I shall seek an early opportunity to visit a maternity hospital and examine more mouths.

Before proceeding I desire to pause a moment to explain that I am opening, not closing an argument. I would like to hear a discussion upon the subject which I have brought before you, and I commit myself to no definite views, but merely call attention to what seem to me to be discrepancies in the views already advanced, and to set down a few facts in relation to occlusion in these cases, the data being obtained from some half dozen or more cases which have passed through my hands for treatment during the past year.

If it be true, as Dr. Brophy says, that a cleft palate is a pressing apart of the maxillary bones, and if it be true as Dr. Cryer declares that the upper teeth develop outwardly in order that they may occlude with and overlap the lower teeth, which latter, so we are told, being set in a jaw of larger circumference must develop inwardly in order to make antagonism, it should follow that the outward development of the upper teeth would occur in a cleft palate case, the maxillae being merely spread

apart, and if this be true does it not follow that the upper teeth should develop considerably outside of the lower?

Measurements in Adult Mouths.

Dr. Brophy says this is often the case. But as I have not seen his models nor his patients, I can neither deny nor accept his statement, for often what seems to be, is proven by close scrutiny to be quite otherwise. I present as my first illustration a set of occluded models (Fig. 1) in which the upper molars occlude entirely outside of the lower, such a case as comes within Dr. Brophy's requirements.

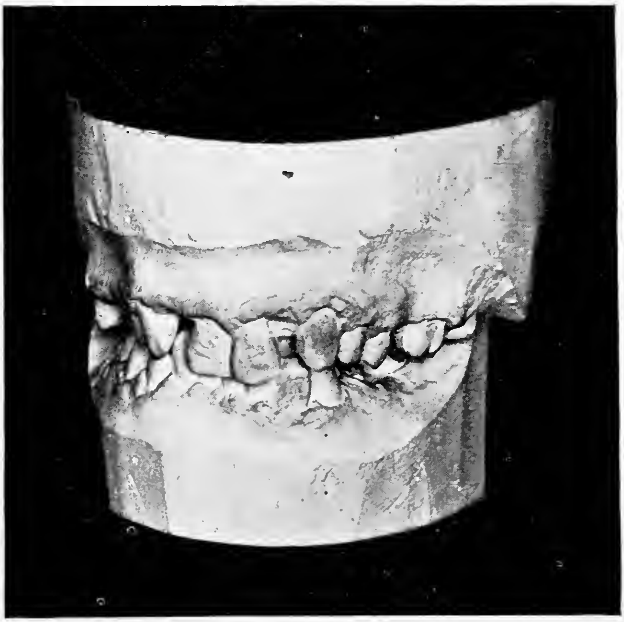


Fig. 1.

The measurement across the widest part of the upper jaws is 70 mm. (Fig. 2). The measurement across the lower jaw at the same situation is 50 mm. (Fig. 3). And the cleft measures 20 mm. Thus we have an instance where the measurements show the difference between the two jaws to be just the width of the cleft. If the orthodontists present would examine these models, and overlook the cleft entirely, I venture to say that treatment would involve widening the lower jaw, and not narrowing the upper. The mandible in the molar region is bent inwardly on both sides and the teeth are tipping to-

Fig. 2.

A cleft through hard and soft palate, despite the fact that vomer and turbinated bones are normal. A unique case.

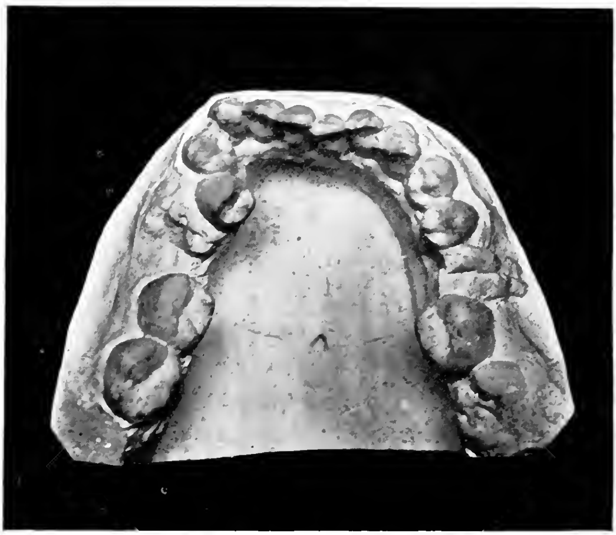


Fig. 3.

wards the tongue. The more we study this case the more interesting it becomes. We have been taught that the lower teeth erupt first and that the upper teeth seek occlusion with them: malposition in the lower jaw should be met by malposition in the upper, but usually we expect to find antagonism of the masticating surfaces: I do not like to call this occlusion. Here it seems almost as though the reverse order has maintained. Seemingly the upper teeth have appeared first and have disarranged the lower. For example the right upper central is tipped palatally and we find a corresponding flattening in the incisive region below. The left central protrudes and the left lateral is in palatal eruption to so great an extent that apparently it has forced outward the lower teeth,

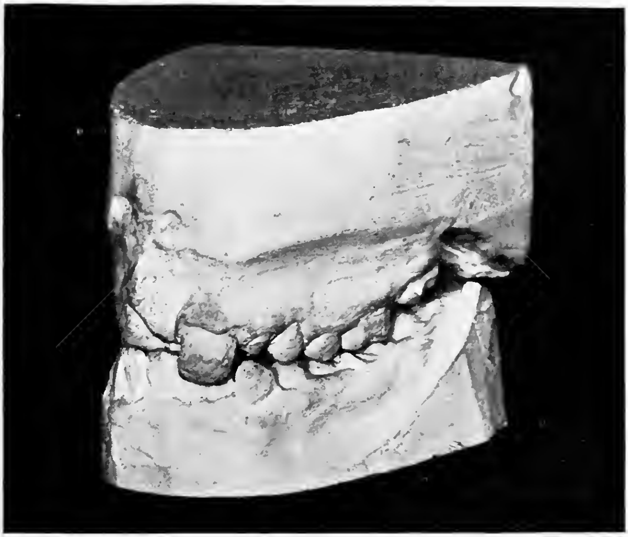


Fig. 4.

so that below we have a bulging. Viewed externally the upper arch does not seem to be assymetrical, nor is it disproportionately large for the face. The molars are erect and do not tip outwardly. Yet the lower molars have failed to make an antagonism and on the contrary are lying entirely within the upper molars when the jaws are closed. The measurements first cited were made across the jaws from imaginary lines touching the buccal surfaces of the molars as they emerge from the gum. If I measure both jaws between imaginary lines resting on the outer surfaces of the alveolar processes, the width is 75 mm. in each instance.

In the second set of models (Figs. 4, 5 and 6), the oc-

Fig. 5.

Fig. 6.

Fig. 8.

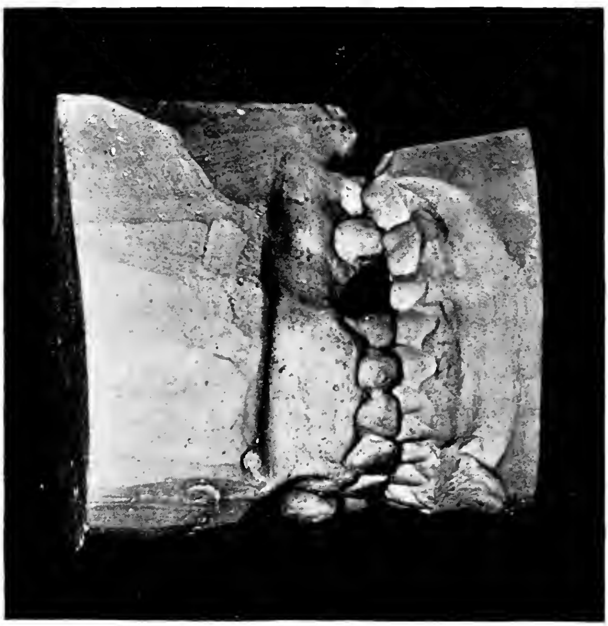


Fig. 7.

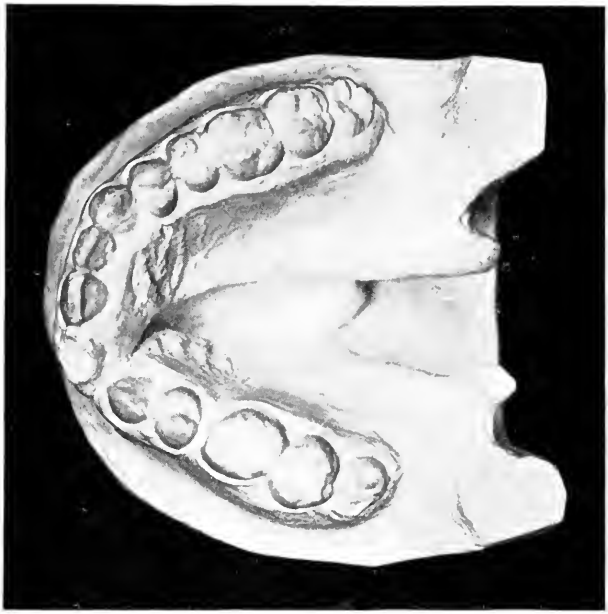


Fig. 10.

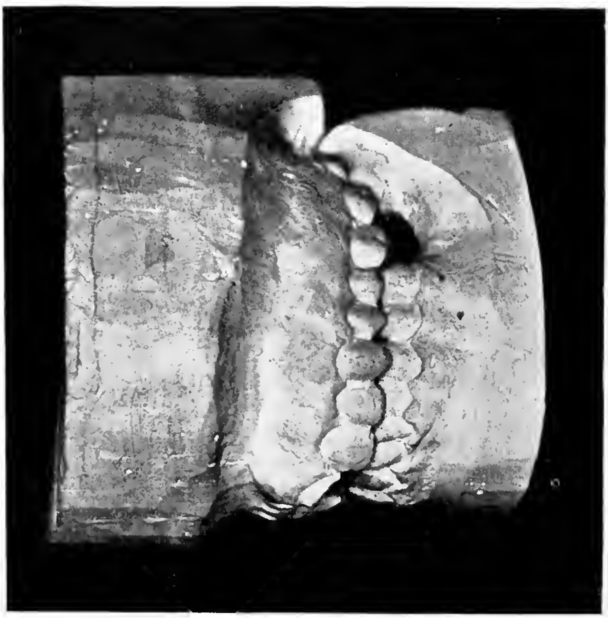


Fig. 9.

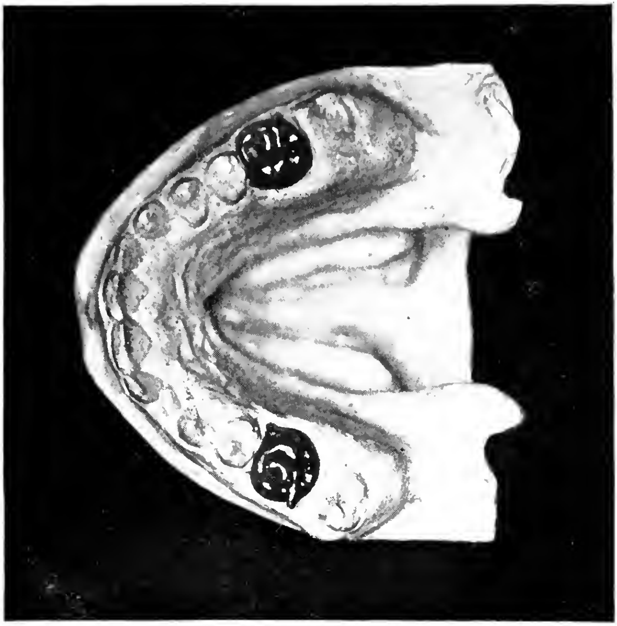


Fig. 12.

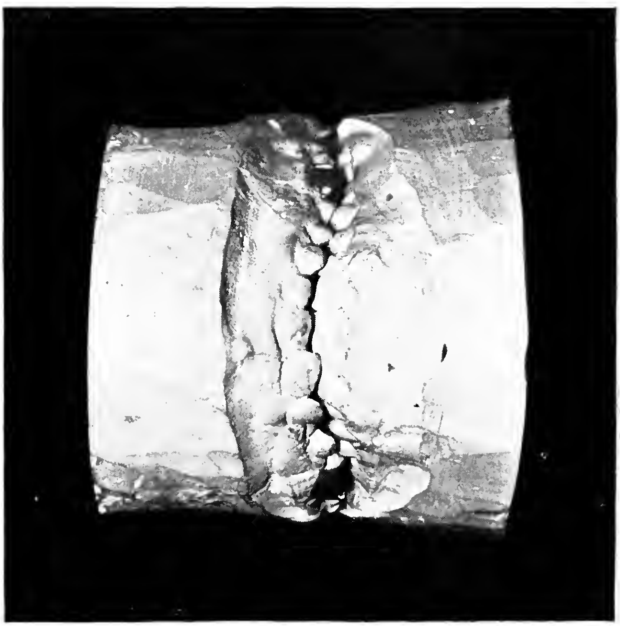


Fig. 11.

clusion in the molar region is practically normal, the widest measurement across the upper jaw is 65 mm., and the lower 55 mm., while the cleft measures 15 mm. Examination from the viewpoint of the orthodontist would indicate that correction and the perfection of occlusal relations would demand a widening of both arches.

In the third set of models (Figs. 7 and 8), the occlusion is practically normal, the only discrepancy being a molar in the upper arch biting palatal of normal. In other words, in spite of a cleft 20 mm. in width the upper jaw appears to be too narrow for the lower.

Fig. 13.

In a fourth set of models (Figs. 9 and 10), the occlusal relations would indicate absolutely normal width of both jaws, yet there is a fissure measuring 20 mm.

The occlusal width of the jaws in the fifth set of models (Figs. 11 and 12) is normal, yet the cleft measures 30 mm., while the jaw itself is only 70 mm. across.

All of the foregoing deal with occlusion of the second set. During the past year, I have had two other patients the upper models (Figs. 13 and 14) of which I present, showing extensive clefts, 20 mm. I have

not the lower jaw models, but beg you to accept my statement that the occlusion in each instance is as good as in Case 5. I do not have these lower models because the first patient passed out of my hands prior to my beginning this collection, while in the second the operation for hare-lip has left the mouth so diminutive that the introduction of an impression tray is impossible. The model shown was made in sections, and at great difficulty, to insure exactness. Under the circumstances the young lady demurred against furthers attempts to obtain impressions. I repeat, however, that in both instances, molar occlusion is absolutely normal.

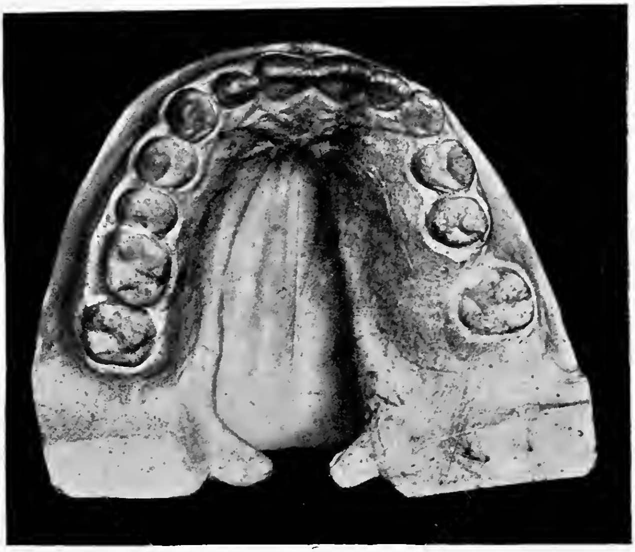


Fig. 14.

I have one case only of a child showing the temporary set. Here again there were difficulties. I procured the first model (Fig. 15), that of the upper jaw, at my first attempt. After that the little one, aged only five, rebelled at any impression taking. The little model of the lower jaw therefore, is not what I should like it to be, and not distinct enough for a photograph. Nevertheless it shows that the molar relations are normal. It is but fair to say that there was no hare lip in this case, also that I cannot give the width of the cleft as the child came to me after two operations had proven insufficient. So far as I know this is the youngest child who has had an artificial velum adapted to her mouth.

Conclusions. Whilst a few cases from practice cannot be considered as offering final proof, I believe that those presented with this paper offer some evidence against the views that have been expressed by Dr. Cryer and by Dr. Brophy. It seems doubtful that the cleft palate can be due to pressure of the mandible against the maxillae during fœtal life. We can of course fall back upon the theory that the true width of the jaws must be measured without considering the alveolar processes, and then argue that occlusion will be obtained by the eruption of the teeth, seeking occlusion and carrying the alveolus

Fig. 15.

with them. This I believe to be probable, yet we find as shown by two sets of models out of the six presented, the same being selected in the order of their occurrence in my practice, that occlusion is not always attained.

In conclusion I offer the following postulates. In clefts which do not pass entirely through the jaw, the intermaxillary bones being intact, occlusion will be normal, or if abnormal will not be dependent upon the cleft, which is to be counted a mere coincidence. In these cases irregularities may occur, but in no greater proportion than in otherwise normal mouths, and they will be subject to the same classification.

Where the cleft does involve the intermaxillary bones, irregularities of the teeth are practically invariable, and present a class distinct from any

to be found in mouths with the palates uncleft. At the same time the occlusal relations will be normal in the molar regions, or, where abnormal, will not depend upon the presence of the cleft, and will be found to fall within the regular classification of molar conditions elsewhere.

Finally, I consider the theory that a cleft palate indicates a pressing apart of the maxillae, to be most doubtful, and certainly not yet proven.

Discussion.

Dr. Edward H. Angle, St. Louis, Mo.

Mr. President: This is a subject in which my experience has not been extensive, but I wish to report two cases that are of interest and that will perhaps have some bearing on the thoughts brought out by Dr. Ottolengui.

In connection with the late Dr. Henry H. Mudd, of St. Louis, I treated a patient with a double cleft of the lips and jaws. You will see by his picture that the face is abnormally wide. The upper dental arch had widened to such an extent that when the jaws were closed the teeth in both the lateral halves of the upper arch were entirely buccal to the lower teeth. It gave the face a breadth greater than that of the Chinamen or the Ainos. This, I think, was brought about by the lack of the normal hoop-like or binding influence of the upper lip. It being severed in front, there could not be the requisite amount of counter pressure to the tongue operating on the inside.

The idea in treatment was to narrow the upper dental arch by drawing the lateral halves closer together. To accomplish this it was found necessary to sever the zygomatic process of both malar bones. After this the narrowing was effected without much difficulty. I think that Dr. Mudd operated upon the soft tissues later.

The other case was that of a young girl eleven years of age who had been operated on for cleft palate soon after birth. The operation had been successful and there was complete union, although the scars in the vault of the arch where the stitches had been taken could be plainly seen. There was this peculiarity about the case, however. The upper dental arch was very narrow. There seemed to be pronounced arrest in the development. It also resisted the force of widening to a very noticeable degree, and required a much longer time to treat than usual, but by patience and persistence, widening a little at a time and then resting and allowing nature to catch up in the growth and development, we have succeeded after nearly three years in getting a very well developed jaw—nearly normal.

Dr. Ottolengui. Did you not find in that case more difficulty in widening the jaw than you would in a normal case?

Dr. Angle. Yes, I have. It has given me a great deal of trouble.

Dr. G. V. Black, Chicago. This is a subject that always has interested me very much because I have had a great deal to do with it. I have had considerable opportunity to study fœtal jaws, and as the paper was being read, it occurred to me that if I had made casts of all jaws that have come to me in my work, it would be a great help just now. I have had, from the earliest

periods of development, practically up to term, some hundreds of these fœtal jaws for purposes of study; many of them were imperfect. It is true when we undertake to gather up the results of abortions we get an unusual proportion of imperfect specimens. But, my memory of this is that the lower jaw is broader than the upper in the molar region; while anteriorly, in forward protrusion, they correspond very closely. And following up the development of the teeth, we find the alveolar process situated on the anterior portion of the bone, not the lingual side of the posterior portion of the lower jaw. So that the lower arch does not correspond with the form of the mandible, but is an arch set on top in the anterior portion and at the lingual side of the molar portion. Therefore, in the normally developed fœtal jaws we find the lower jaw broader in the

molar portion, if we can conceive of it having a molar portion at that time, and to a degree which is broader than the upper. If we take a large number of these I am convinced that we will find not only that the arch is broader than the normal, but that the whole face is broader than the normal. There is a standing apart of the bones and a dropping of the nose into the breach, as it were. One of the conditions that is so extremely difficult to remedy in the reproduction, as we may say, of the facial expression is that dropping of the nose. I have no measurements but depend simply on my memory of cases I have seen in the last forty years. For many years I watched these cases, doing much operating myself, and seeing many operations done by others, where we had cases coming into one central hospital from seven or eight States. Few men in those times operated on these cases so that we had a great gathering in of them.

Occlusion.

There seems to be no question that the teeth seek each other as they are protruding from their sockets. The position of the lips and tongue, and the action of the muscles everywhere tend to bring the upper teeth in contact with the lower, and if the upper arch is broad the tendency will be for less inclination of the lower teeth. We have seen today some models that would seem to disprove this. In one case the lower teeth were lingual to the upper for the full width. Such instances in occlusion occur for some reason that seems almost inscrutable.

Etiology of Cleft Palate.

As to the cause of cleft palate: The theory presented that it is caused by the position of the fœtus in utero seems to be rather far-fetched. I hardly can imagine that such would be the case. Cleft palate, as I have studied it, seems to be largely an hereditary condition, cropping out here and there in families. I remember one family in which the father and four children had cleft palate; and many cases have come under my observation that tended to confirm this view; that there has been something in the past history of the family that tended to produce this condition.

As to the matter of occlusion: That the teeth come into occlusion is shown in these cases, except in the front of the mouth where the cleft is double. There we always find irregularities of the teeth. Even where the cleft is single we have in the front of the mouth malocclusion or malalignment. The bones are not developed fully and the teeth are thrown out of position.

Treatment.

As to the compression of the upper arch in the treatment of cleft palate: This compression is of temporary service only, no matter how often it is done It used to be our habit, in cases of hare-lip, to close the lip first and then,

perhaps, the soft palate. Then we waited for the effect produced by drawing these two parts together before we closed the hard palate. That was the regulation procedure and it did narrow the fissure. This is accomplished now by forcible compression of the parts, and while this brings the jaws and alveolar processes closer together, I think you will find that this is recovered from completely in the process of growth afterward. It seems to me that this should be done, as it will not affect the size of the arches in after life.

Dr. Ottolengui.

I want to call your attention to one or two of these models. Usually where the cleft is through the hard palate we find the vomer, deflected to one side. The turbinated bone on one side is atrophied; on the other side it is hypertrophied. Fig. 2 shows a unique instance. The turbinated bones are in their normal position, and so is the vomer; yet this is the very case in which the upper jaw telescoped the lower. The cleft measures 20 millimeters. Despite the fact that the nasal bones are normally placed this is the only case in the collection where the upper jaw bites completely over the arch. How is it that the upper nares is normal if the cleft was caused by pressing the maxillae apart? This cleft was undoubtedly produced by lack of development of the palatal processes. This man also suffered from slight deafness, or was what he called "hard of hearing." His deafness was cured within a week after the appliance was put on. I do not venture to explain that, except the possibility that in making this obturator I departed a little from the usual procedure. Heretofore I have made my impressions of the back of mouth with softened composition, but the muscles did not seem strong enough in this case to compress that material. So I removed most of it, put plaster of paris over it and allowed him to swallow. In that way I obtained an obturator that completely occluded with the parts, and that might have made the difference in his hearing. Dr. Brophy has found that this improvement sometimes occurs after operations on cleft palate. The catarrh that accompanies these cases is also cured as soon as the cleft palate is cured.

Regulating Cleft Palate Cases.

A word about regulating these cases. Nearly all these cases require widening of the anterior portion of the arch. I have a method with which I claim usually to be able to widen the jaws by opening the suture between the bones. I have never failed yet in normal mouths to get the widening I wanted. In one of these cases, Fig. 13, the maxillae are absolutely separated, and yet no pressure I could put on the jaws would force them any further apart. I used an Angle expansion bar and drew the teeth out, one at a time.

Heredity. I want to say a word about heredity. Many of my patients ask me whether the fact that they have cleft palates should preclude their marriage. I made an obturator for one young man about eight years ago, and from his speech you scarcely could accuse him of anything except a slight cold. Yet his conscience was pricking him about getting married. His sweetheart did not know of his affliction. I told him not to say anything about it because his sweetheart never would know anything about it. I have kept very accurate count of these cases that have come to me and I have yet to find one that can be traced to heredity, where parents, grandparents or great grandparents have shown the same condition. In the next number of the ITEMS OF INTEREST will appear a paper on "Maternal Impressions," in which the author tries to show that these cases are due to fright or some impression on the mind of the mother. I do not believe that maternal influences have any bearing on these cases. And I do not believe in heredity. If you will study the whole trend of the races, you will find that nature always endeavors to preserve the racial type; there is no effort to reproduce abnormalities. There always is a trend towards the normal; so much so that it has been figured out, I think, that the real degenerate ceases to be prolific in the third generation. Otherwise, what would we have? If all these creatures were bred over again the world soon would be filled with these abnormal cases. Yet these cases are about the same, proportionately, year after year. They do not increase.

Dr. Black cited cases where this condition existed in families. I know a case of a woman who had four children in succession, all with cleft palate, and the fifth child was normal. There was no history of cleft palate anywhere in the family. All I can see in these cases is coincidence. If we were to count all the cleft palate cases in the world, say a million, would it be strange to find that some of the parents also have cleft palates? I must ask for further evidence before I am willing to keep my cleft palate patients from getting married.

Dr. Black. While that might account for a large number of cases in which there is no evidence of heredity, yet the next batch of cases may be such as to upset you entirely on that point.

Dr. Ottolengui I expect to see a rose bush have roses. If you graft some other flower onto this bush it will have a few such flowers, but when it goes to seed I would expect the forthcoming plants to produce roses.

A Study of the Peridental Membrane from the Orthodontist's Standpoint.

By Dr. Frederick B. Noyes, Chicago, Ill.

I feel that I owe the Association an apology in presenting the present paper, for it had been hoped that we could report the results of some new studies of the physiologic and pathologic conditions resulting from the movement of the teeth. My other work, however, has been too heavy for me to undertake such a task, and I only offer some facts in regard to the peridental membrane of special interest to the orthodontists which have been gleaned from my previous work on these tissues.

The Peridental Membrane.

The peridental membrane may be defined as the tissue that fills the space between the surface of the tooth and the bony wall of its alveolus, surrounds the root occlusally from the border of the alveolus, and supports the gingivus. I want to emphasize the three things in the definition, for the peridential membrane does not stop at the border of the alveolar process, but continues to clothe the surface of the root as far as the tissues are attached to it, and supports the gingivae, which should overlap the gingival portion of the enamel, and fill the inter-proximal spaces. For this reason especially, the name which has often been used for it "alveolar-dental periosteum," is not suitable, and further, because that term implies a sort of double membrane, which is a misleading view of that membrane which attaches the teeth.

For convenience of study, the membrane has been divided into three portions: First: The gingival portion surrounding the root occlusally from the border of the alveolar process and supporting the gingivus: Second: The alveolar portion from the border of the process to, or about to, the apex of the root; and third: The apical portion filling the apical space through which the vessels enter the pulp.

The membrane is a continuous covering for the root and the divisions are purely for convenience. In the alveolar portion, there is, of course, no question as to the extent of the membrane; it reaches from the surface of the cementum to the surface of the bone; but in the gingival portion there might be some question as to where the peridental membrane stops, and the fibrous mat of the gum tissue begins. In studying transverse sections, however, in this portion it is seen that there is a rather definite boundary between what would be called peridental membrane, and its union or fusion with the much coarser and irregular mat of the gum tissue.

The distance to which the fibres are traced is seen to be considerably greater on the lingual than on the labial side, and there are other differences in the arrangement of the fibres which will be noted later.

The peridental membrane belongs to a very large class of connective tissue membranes, embracing such structures as capsules of glands, tendon sheathes, synovial and articular membranes, and the periosteum which is its nearest relative, many of whose functions and characteristics it possesses. Like most of these membranes it is composed chiefly of white fibrous connective tissue, containing many blood vessels and nerves, but few capillaries.

The differences in these membranes are chiefly in the character and arrangement of the bundles of fibres and their adaptation to the functions which the membrane perform. It is, therefore, perhaps well to begin with the description of the fibres of the peridental membrane and their arrangement, with reference to its functions.

Fibres of the Peridental Membrane.

We describe two kinds of fibres in the membrane: First, the principal fibres which constitute the chief bulk of the membrane and perform its physical function of maintaining the tooth in position. They may be defined as those fibres, which, springing from the surface of the cementum pass across the membrane and are attached at their other extremity to the bone of the alveolar process, the outer layer of the periosteum at the border of the alveolus, the fibrous mat of the gum, the cementium of the approximating tooth or the epithelium of the gingivus; second, the interfibrous or indifferent fibrous tissue which fills the space between the principal fibres and surrounds and accompanies the blood vessels and nerves; these fibres are much smaller and more delicate in character, and are apparently simply to fill in the spaces.

Functions of the Pericementum.

The membrane performs three functions; physical; the support of the tooth and the surrounding tissue in relation to each other; second, a vital function; the formation of cementum on the surface of the root and bone on the wall of the alveolus, and when occasion demands, the absorption of the root or the process; third, a sensory function. It is the seat of the sense of touch for the tooth.

The physical function is performed by the principal fibres and their arrangement is beautifully planned with reference to the forces to which the tooth is subjected. Before describing this arrangement, just a few words in regard to the fibres themselves. They are larger or smaller bundles of fibrils, with all the structural characteristics of the white connective tissue fibres, as found in the tendons and elsewhere. They spring from the cementum as bundles of fibrils, which usually break up into

smaller bundles, or fibres, to be re-united into larger bundles where they are built into the bone. The fibrils, or strands of the fibre, are very minute, wavy and do not branch. The cells are found usually of spindle or stellate form, squeezed in between the bundles of fibrils, and are much more numerous in the young than in the old membrane.

It is hard with any series of sections to illustrate the arrangement of the principal fibres springing from all parts of the root, for this can be made out only by reconstructing them in the imagination after a study of many sections. I am going to ask you to make such a use of your imagina-

Fig. 1.

Longitudinal section of the peridental membrane in the gingival portion, showing the lingual gingivus. E, epithelium; F, fibres extending into the gingivus; F¹, fibres joining the outer layer of the periosteum; B, bone at the border of the alveolus; C, cementum; D, dentin.

tion and to picture to yourselves from the illustration the direction and arrangement of the fibres.

Beginning at the gingival line, or the first point where the tissues are attached to the surface of the root, Fig. 1, the fibres springing from the cementum bend sharply occlusally, and pass up into the gingivus or free margin of the gum, which overlaps the enamel and fills (normally) the interproximal space. These fibres, as they pass into the gingivus break up into smaller bundles, interlace with circular fibres, which run around the tooth in the gingivus, and are lost, in the fibrous mat which supports

the epithelium. Fig. 2. They are much more plainly seen, and are larger and more numerous lingually where, in biting, the food is forced against the low and rounded gingivus. One need only to bite into a hard apple to demonstrate the force which tends to pound down the gingivus. The circular fibres or circling fibres, together with these, hold the gingivus close against the surface of the tooth and keep it in position. In those cases of gingivitis where we see the gingivæ hanging away from the tooth, as if

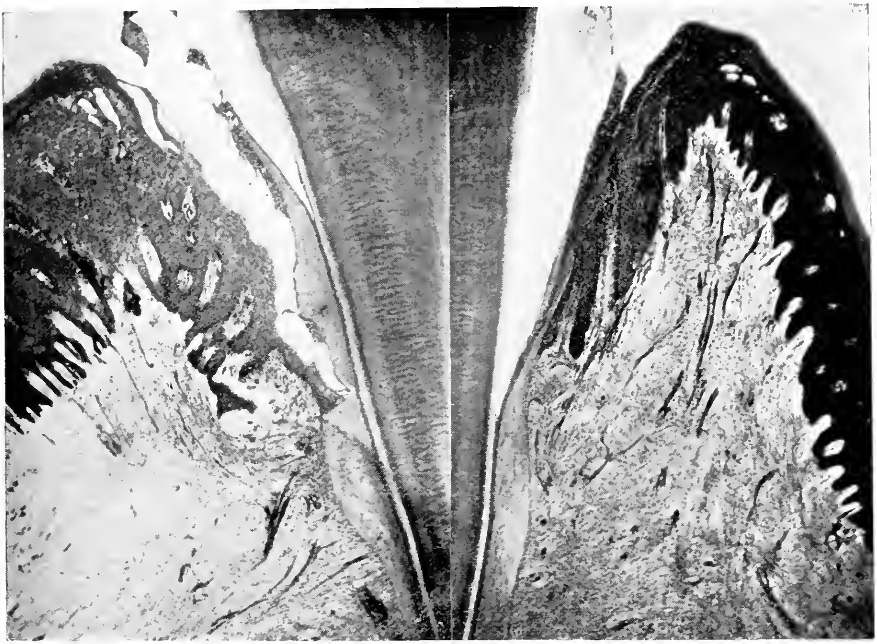


Fig. 2.

Labial and lingual gingivæ from the same tooth, the lingual to the left, the labial to the right.

everted, the circling fibres are relaxed and the connective tissue between the epithelium fingers of the gingivus are inflamed and infiltrated, causing the appearance.

Just a little beyond the first point of attachment to the surface of the tooth, the fibres pass out from the cementum, on the labial and lingual sides, and are attached to or lost in, the fibrous mat of the gum, but the distance to which they retain their identity is characteristic of different

positions, and the boundary between peridental membrane and gum tissue, is fairly definitely marked.

In a transverse section in this portion of the membrane, Fig. 3, these fibres can be traced to better advantage. On the labial the gingivus is comparatively thin, and the fibres are comparatively soon lost in the gum tissue. Toward the mesial and disal angles of the root the fibres swing

Fig. 3.

Transverse section in gingival portion of the peridental membrane, showing the roots of two incisors. E, epithelium on the labial; G, fibrous mat of the gum; F, fibres extending from tooth to tooth; P, pulp.

around laterally, and branching and re-branching, as they go, pass to the next tooth, to be inserted into the cementum covering its root, and all along the proximal surfaces of the root, the fibres springing from the cementum are large, and pass to the cementum of the next tooth, branching and interlacing as they go, and winding around blood vessels and bundles of fibres which are passing up into the gingivus.

The fibres are of great importance; they not only hold the teeth in contact, but they form the foundation of the gingivus, which should fill

Fig. 4.

Longitudinal section at the border of the process, showing fibres extending from the cementum to the bone. D, dentin; C, cementum; B, bloodvessel; F, fibres of peridental membrane extending from cementum to bone; A, bone of the alveolar process; P, periosteum; G, gum tissue.

the interproximal space, and the first symptom which results when they are cut off from the cementum by absorption or violence. is the sagging of

the gingivus. It is a commonly known fact that when a tooth begins to move from pyorrhea it moves away from the pocket, that is if the left center has moved distally, a pocket will be found mesially. This is because the fibres have been cut off on the mesial and still being attached on the distal they pull the tooth in that direction.

In cases where central incisors are widely separated it is very difficult to make them keep their normal position, after they have been moved to contract, because the fibres are not continuous from the cementum of one tooth to the cementum of the other, and the normal bond is difficult to produce. It is possible that strictly surgical means might be effective in such cases.

In fitting bands for regulating appliances or crowns, these fibres must not be forgotten, for a band that is too wide, not properly shaped, or which does not fit, will do damage, that is often difficult to repair, and the same damage may be produced by ligatures.

On the lingual side the fibres can usually be traced further before they are lost in the fibrous mat of the gum. Fig. 4. The fibres passing from tooth to tooth or cementum to gum tissue, constitute the greatest number of fibres in the gingival portion of the membrane, but a little further apically, just before the alveolar border is reached, many large fibres are seen, which spring from the cementum and incline apically as they pass away from the root; on the proximal sides these fibres are inserted into the bone of the alveolar border, forming the septum between the alveolus, but on the labial and lingual sides they unite into large bundles, forming a very coarse network, and are attached on the outer layer of the periosteum, covering the labial and lingual surfaces of the bone. These fibres are a very definite and pretty dense layer which has been called the dental ligament. It probably has some function in holding the tooth into the alveolus.

At the border of the process the fibres pass directly from the cementum to the bone at right angles to the axis of the tooth. These fibres are large and in their course do not branch nor interlace as much as in other portions of the membrane, though in some places they spread out somewhat to be inserted into the bone.

The arrangement of the fibres as seen in transverse sections is especially important. Fig. 5. At the central portion of the labial, lingual, and proximal surfaces of the root; the fibres radiate from the surface at right angles to the surface. But at the angles, the disto-labial, disto-lingual, mesio-labial, and mesio-lingual, they run to the bone almost at a tangent to the surface. And these points often show especially large and strong bundles which spread out considerably in their attachment to the bone. They hold the tooth against the forces which tend to rotate it in the

Fig. 5.

Transverse section in the occlusal third of the alveolar portion of the peridental membrane. M, muscle fibres of the lip; P, periosteum; B, bone of the alveolar process; F, fibres supporting the tooth against rotation; C. cementum.

alveolus. The presence of these explain the conditions which exist in rotating teeth. Two sets of tangential fibres are stretched and two are relaxed, but no absorptions are produced and consequently none of the fibres are cut off. And it takes a long time for the fibres to be reformed or adapted to the new position into which the tooth has been forced.

In the occlusal third of the alveolar portion of the membrane the course and character of the fibres is very much as has been described. But in the middle and apical thirds they are inclined more and more occlusally in passing from the cementum to the bone, so swinging the tooth in its socket, supporting it against the force of occlusion. In their course, they are often seen to arise as large bundles and spread out in a fan-like form, to be inserted into a larger area of the alveolar wall, leaving room between the branches close to the bone for the larger blood vessels of the membrane.

In the apical portion the fibres radiate in all directions, and spread out a great deal over the comparatively large area of the bone surrounding the apical space. Reviewing them it is seen that the fibres in the occlusal third of the alveolar portion and the apical portion support the tooth against lateral pressure and rotation, while those in the middle and apical thirds of the alveolar portion swing the tooth against the force of occlusion. Could there be a more perfect adaptation of structure to function?

Construction and Destruction of Alveolar Process.

After having considered somewhat extensively the arrangement of the fibres of the membrane with reference to the physical functions of the peridental membrane, I want to consider somewhat imperfectly the formation and removal of the alveolar processes, which seems to me to be characterized by an apparent wastefulness of activity, nature seeming to build up a tissue for a temporary purpose, only to tear it down and rebuild with a structure better suited to the conditions.

In the development of the jaws, the formation of bone has not been studied carefully and consecutively enough to give us at all a satisfactory knowledge of it, some authorities stating that it is entirely endo-membranous; others that it is partly endo-cartalagenous and partly endo-membranous. Even the centers of formation and manner of development are comparatively imperfectly known. Some authorities state this Meckle's cartilage is entirely absorbed without being transformed into bone; others that it is at least partly transformed into bone and then absorbed in the process of growth.

But without going into uncertain fields we may safely say the first appearance of bone in the mandible is the formation of spicules or plates of bone in the undifferentiated meso-dermal tissue producing a network of

plates with large nutrient spaces. The formation progresses until a supporting and protecting framework is produced in the body of the mandible, then on the surface of the cancellous mass a definite periosteum is gradually produced, which covers the surface of the spongy mass with more or less perfect layers of sub-periosteal bone. The formation of bone spicules appears first in the region of Meckle's cartilage, between the cartilage and developing tooth germs and proceeds in such a way as to surround the cartilage rod, and grow up around the tooth germs on the labial and lingual, first inclosing them in an open trough, later separating them by septae and inclosing them in separate bony crypts. These crypts are bounded by comparatively compact plates with small narrow spaces, but are not strictly a continuous layer of sub-periosteal bone, but have many large openings into the more spongy structure. As soon as the bony frame work of the mandible is covered by a periosteum, the growth proceeds by the formation of subperiosteal bone which is at once destroyed, from the inside and converted into Haversian system bone, with the lammelae arranged concentrically around nutrient canals, which, however, remain large, giving an open and cancellous structure to the tissue.

At birth this is practically the condition of the jaw. Meckle's cartilage has disappeared, whether by absorption, or conversion into bone and then being absorbed.

The changes in the shape of the jaw with the development of the teeth have been described so often that I will refer to them only briefly, and to remind us that the development of the face and the changing expression from the child to the adult is accompanied by the development of the jaws and alveolar processes, and a movement downward and forward of the upper incisors; upward and forward in the lower incisors; the change is in the lower portion of the face, increasing the length of the nose, lips and chin. We may represent a child's face by drawing an oval and placing the eyes in the center vertically while an adult face is represented by an oval with the eyes at the junction of the upper and middle thirds.

We are especially interested in the development of bone which leads to these changes, and this development is associated with the eruption of the teeth, the bone growing up around the roots as the teeth come into position.

As the tooth lies in its crypt at the time of birth it is not attached to the bone by any fibrous attachment, but is surrounded by the fibrous wall of its follicle. The bony covering of the crypts are absorbed and as the crowns move toward the surface of the mucous membrane and emerge from it the roots are developed, and the fibres are built into the cementum on one side and the crypt wall on the other. Just

Fig. 6.

Longitudinal section through the border of the alveolar process, showing manner of formation. B, solid sub-periosteal and sub-peridental bone; A, absorption space; H, B, Haversian system bone rebuilt; C, cementum; P, peridental membrane.

at what point and in what way this is done has not been shown, nor at what stage in eruption the first attachment of fibres to the surface of the root occurs. It seems, however, that there is an attachment of the fibres at the gingival line by the formation of cementum and a building of them into the border of the crypt by a new formation of sub-peridental and sub-periosteal bone. And as the tooth is erupted and the root developed, the border of the crypt is carried occlusally, changing the crypt into the alveolus.

A section through the alveolus of a temporary tooth of a sheep will show this method of growth. Fig. 6. There is first a solid ring of bone formed around the border of the crypt; in other words, osteoblasts between the fibres of the connective tissue form and calcify bone matrix around these fibres and on the bone of the crypt margin. This soon becomes of considerable amount and in section is triangular. The osteoblasts from the medullary spaces below now dissolve out the central part of this ring and it is replaced by Haversian system, or concentric lammelae, so giving the spongy character to the greater mass of the process, while the more solid layers of sub-periosteal bone remain only on the labial and lingual surfaces of the process, the sub-peridental layer with its imbedded fibres lining the alveolus.

When the absorption of the roots of the temporary teeth begin, there is first an appearance of many osteoblasts in the medullary spaces of the cancellous bone over the crypt of the permanent tooth, removing not only the crypt wall, but also the bone of the temporary alveolar process. This cuts off the attachment of some fibres and there is a compensatory formation of new bone at the border of the temporary alveolus to attach some new fibres. At the same time the surface of the root is attacked near the apex and some fibres are cut off, and a considerable scoop made into the dentine but the attack soon stops here, and a slight rebuilding occurs, reattaching the fibres, while a large excavation is made a little farther occlusally; then a rebuilding occurs in the second place and a still greater excavation is made in the first point of attack. This being continued the tooth is finally left with a partial ring of cementum at the enamel border, attaching fibres which are fastened only to the ring of the old alveolus, or the fibrous tissue if that is all gone. The coming permanent tooth has no temporary alveolus to which to be attached, but is attached to the rim of its crypt, which grows upward as the tooth erupts and so forms the new alveolar process.

We cannot emphasize too strongly the fact that the great portion of the bone of the process remains open and cancelous in character, and that the layer of compact sub-peridental bone lining the alveolus and sub-periosteal bone covering the labial and lingual surfaces, remain thin. It

is probable that often the absorptions produced by pressure in moving teeth are not so much in the sub-peridental bone lining the alveolus and in the cancellous bone between the plates, and the movement may be thought of as moving the root and the lining of its alveolus bodily through the light cancellous structure. This idea has been impressed upon me in observing the absorption in advance of an erupting permanent tooth. There is pressure by the growth of the germ in its crypt, but the wall of the crypt is not first attacked, and it does not seem to be attacked from the inside at all, but the cancellous bone above is attacked all through it and the crypt wall is moved occlusally, and is dissolved from outside, inward.

If the absorptions produced in moving the teeth were primarily in the peridental membrane and on the wall of the alveolus, I would expect more damage to the roots and consequently to the teeth in extensive movements.

It is probable then that in moving incisors forward the labial plate of bone is carried bodily forward, and in moving them lingually while the thickness of the process is much greater, it is chiefly of cancellous character through which the root is moved easily, the bone being absorbed in front of it.

Discussion.

Dr. Edward H. Angle, St. Louis, Mo.

I was very much pleased with this paper, which ought to and will awaken the keenest interest in all of those who are not empiricists in the field of orthodontia. The Doctor has considered the tissue with which we deal most, and yet to which we give the least attention in our studies; it is the tissue about which we are most puzzled, for we change the positions of teeth only as we modify this tissue, and we succeed in holding the teeth in their changed positions only as we succeed in establishing harmony of this tissue with the other factors in occlusion.

I have long been a believer in and an admirer of Dr. Noyes, and it is with pleasure I noted among the many wonderful pictures he has given us to-day, two or three that were made by him originally for my book. There are certain things, however, about which I wish he had told us more. I tell you this tissue is as yet much shrouded in mystery. I have been more puzzled with its behaviour than with any other one thing in orthodontia. Why is it that this tissue acts so differently under similar conditions—never twice alike? Why is it that there is such a difference in the force required to move teeth in patients of the same ages? Why

is it that we must retain teeth so much longer in one case than in another of the same kind? Why is it that it requires infinitely longer to retain teeth that have been rotated than those that have been moved from lingual or labial to normal occlusion?

In some rare instances I doubt whether we can retain teeth long enough to prevent their returning to their former positions. If this be true, may it not follow that this tissue never becomes physiologically reorganized? I have retained teeth for three years in one or two instances, and as soon as the retaining devices were removed the teeth moved partially back.

What peculiarity do these fibres resisting rotation, possess over those laterally distributed? Why is it, too, that when we elevate a tooth in its socket, say a first molar, that we cannot keep it there? Why does the peridental membrane pull it back, or do the suspensory fibres have to be entirely reorganized? What are the changes, and what is the probable time necessary for them to regain their full function of suspension?

Finally, I am forced to ask this question. Does this membrane and the alveolar process, after being once fully formed, ever become normal again after tooth movement has been carried on to any great extent? I have had cases that led me to doubt this, as for example, you will remember a case I reported before this society at its last meeting—that of a lady thirty-eight years of age, whose first permanent molars had all been extracted at the age of nine, in accordance with that most ignorant and baneful of all advice given as a preventative of malocclusion by dentists, to trusting parents. Of course the remaining occlusion was ruined, and in order to remedy it, it was necessary to tip into upright position the leaning second molars and bicuspids, thus making space for the insertion of artificial substitutes for the lost teeth. These teeth must have remained in these tipped and abnormal positions for something like twenty-five years, and yet they moved back into their original position with far less resistance than would have been the case had they been moved for the first time. I have had similar experiences in the shifting of teeth used as anchor teeth which had been moved from their correct positions by bad efforts in regulating, years before.

I do not wish to be understood as saying that teeth once moved do not again become of normal firmness, but I am forced to believe that under certain conditions this membrane never does regain its normal tone. If so, what condition does the membrane take on, and what is the range in limit of these conditions?

These are things we should know, for they vitally concern us as orthodontists.

If suspicion does throw doubt on these points, does it not also teach us

a potent lesson—that youth, or the period of their eruption, is the time to conduct the movements of the teeth so, as nearly as possible, to allow nature to develop this membrane and the alveolar process in the positions which they should occupy.

How greatly do we need histologists who are also orthodontists to further carry on the investigation of this membrane.

There is another point which I would like to have Dr. Noyes clear up, for some of my orthodontist friends, and I differ as to some of the physical properties of this membrane. I have taught, and believe, that the fibres of this membrane are not elastic, but absolutely inelastic—just as inelastic as nature can make them. Some of my friends believe they stretch, as they claim is proven by the slight movement possible upon pressure with all teeth. Dr. Noyes has also used the term "stretching" in describing these fibres to-day. Now I believe that this apparent stretching is not due to the elasticity of the fibres, but to the straightening of them when they are put upon tension, the fibres in repose being necessarily crooked and bent, owing to their interblending and crossing in order to pursue the many directions they of necessity take in resisting tooth movement. How could they resist tooth movement and be elastic? I am sure Dr. Noyes can clear up this point for us. And I wish to thank him for giving us one of the most interesting and instructive papers ever brought before this society.

Dr. Noyes. Dr. Angle has expressed my opinion exactly. These fibres are as inelastic as nature can make them, and, perhaps, it is better to say that the fibres are put on a tension, because none of these fibres run perfectly straight. They are more or less wavy and will straighten out, but they do not stretch. The bone is more elastic than these fibres.

Dr. Webster. Will Dr. Noyes explain why a tooth in torsal occlusion can be moved into its normal position if the fibres are not elastic?

Dr. Noyes. There is a tension put on the fibres for a long time.

Dr. Webster. Why should there be so much more difficulty to retain a tooth when rotated if not because of the peculiar attachment of the fibres and their stretching?

Dr. Noyes. They are elastic only as a coiled spring is. It is a natural thing for that fibre to be wavy; as much so as it is for a coiled spring to be in a spiral.

Dr. Webster. Does that not also obtain in moving a tooth into labial or lingual occlusion?

Dr. Noyes. No, because you have a pressure which produces absorption and a rebuilding of the bone.

Dr. Webster. I mean on the side from which the tooth is moved. There must be a stretching of the fibres.

Dr. Noyes. In that case there is either an absorption which cuts off the fibres from their attachment, or else the rim is moved along with it. I do not know which occurs. I have no section showing that. Speaking with Dr. Black about that a few days ago, he told me that he was satisfied that in extensive movements labially or lingually, a considerable cavity is created. Now, the question is are the fibres pulled out of the bone; are they cut off from the bone; or is the bone absorbed?

Dr. Webster. Or would the fibres stretch?

Dr. Noyes. I would risk my reputation that these fibres do not stretch.

Dr. U. E. Barnes, Cleveland, Ohio. I think we are falling into error on this question of tension and elasticity. Dr. Angle says that piano wire is not elastic; and Dr. Noyes says that these fibres are not elastic. I believe they must be. Piano wire is elastic; very much so. Rubber possesses but little elasticity, although we believe it to be very elastic. Glass is, perhaps, the most elastic substance, although we look upon it as possessing no elasticity at all. Elasticity, as I understand it, is the tendency of a substance to return to its original form after compression or stretching. Why is it not reasonable to suppose that these fibres are so elastic that we cannot pull them out; that that tension stays there. I have noticed in some of my cases in which I have moved the body of the alveolus that the tooth has remained in position, and where the alveolus does not go with the tooth there is a tendency for the tooth to return. I believe that these fibres are elastic.

Dr. S. H. Guilford, Philadelphia. So far as I know Dr. Black was the first one to say that the fibres in peridental membrane were of the white, inelastic, variety. Assuming that he was correct, I included that statement in the last two editions of my work on orthodontia. But I must confess that now I do not believe that to be true. Dr. Black assumed that to be true, but gave no reason for it. I believe that these fibres are elastic, because if they are not, what produces that tremendous tension which draws a tooth back into its original position?

After the tissues have readjusted themselves, what is it that continues to pull a tooth back into its original position? I cannot see how it can

be explained except that it is the elasticity of the tissue that does this.

Dr. N. S. Hoff, Ann Arbor, Mich. I know nothing about these fibres, but I have had some experience in straightening teeth, and I have met some of the difficulties that you encounter. But this question of elasticity never puzzled me very much; I do not care whether the fibres are elastic or not. It is not a matter of very great importance. It is the tissue or organ that is of importance in this connection. I have had a great deal of difficulty in trying to move teeth in which this organ had been subjected to diseased conditions, and as a consequence it resembled scar tissue; it had lost its elasticity. In order to move the tooth much force would have to be used, and when you have succeeded in moving the tooth you must retain it in position for a long time before it will stay. I have destroyed the peridental membrane and have lost the tooth in consequence.

I think we will have to go further than these white fibres. We must look to the structure of this organ and the condition in which we find it. Dr. Angle brought this to my mind very forcibly; that it is the condition of the membrane itself in which we are concerned. Whether or not it is healthy is an important question. You are all inclined very favorably to changing the position of these teeth at an early age, and Dr. Noyes suggested that the best time is when the new bone is forming. Why? Because it is forming in a natural way. Bone will not make cicatricial tissue until it has formed naturally, and, it seems to me, that that is the point you want to study.

I do not want to discourage the work Dr. Noyes is doing, because he is doing well; but we must continue our study of the histology before we can appreciate the pathologic conditions we have to encounter. I wish Dr. Noyes would continue his work and give us the physiology and pathology of this issue, for then we will know more about these matters.

Dr. Noyes. We are getting into misapprehension because of a technical matter. There are two kinds of connective tissues; the white and the elastic. The latter are called elastic because they stretch. The ligamentum nuchae of the ox is composed almost entirely of yellow elastic fibres; so, too, the wall of a blood vessel. The statement by Dr. Black, referred to by Dr. Guilford, was not assumed. It was based on the recognition of two kinds of fibres in the tissue. White fibres are soluble in pure acids and alkalies; elastic fibres are not soluble in acids or alkalies. A thin section of peridental membrane, if treated with these solutions, will have its white fibres dissolved and the elastic fibres, if present, would be left intact. This is proof positive that these fibres are of the white variety and not of the elastic

variety. There are very few fibres of the elastic variety in peridental membrane; the principal fibres are of the white variety.

Dr. Guilford. Dr. Black makes another statement to account for the going back of the tooth. He says that the fibres cross each other diagonally, and that when the tooth is moved they straighten out, and when the tension is relaxed they return to their original position. Is that true?

Dr. Noyes. That is correct; but the discussion has centered itself on the question whether these fibres are elastic or whether they straighten out.

In regard to the change in the position of the teeth after they have been moved, I cannot give the reason for that until I have made more sections of jaws showing the different conditions and changes that are wrought by these movements. Human jaws are very hard to get and that necessarily hinders the work very much. The conditions obtaining in animal jaws are not the same as those obtaining in human jaws. Then, too, there is a great difference in the cell activity of different individuals and that must be considered as a factor in these movements. I certainly will continue my work, and I hope that at some time in the near future I will be able to give you results that will be of assistance to you in your work. I thank you very much for your attention.

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FOURTH ANNUAL MEETING
HELD AT CHICAGO, ILL.
SEPTEMBER 28th, 29th & 30th
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FOURTH ANNUAL MEETING
of the AMERICAN SOCIETY
OF ORTHODONTISTS

The Upper First Molar as a Basis of Diagnosis in Orthodontia

By Edward H. Angle, M.D., D.D.S., St. Louis, Mo.

Importance of Diagnosis.

Diagnosis in orthodontia, of course, precedes and is entirely distinct from treatment, yet it is of equal and, if possible, greater importance, for it must govern each and every step that follows. On it may depend weeks, months, and even years, of valuable time of both patient and operator, to say nothing of the inconvenience of patients, parents and friends as well, ofttimes, as no inconsiderable expense which sometimes means sacrifices as pathetic as they are heroic. On diagnosis should depend each hour in the treatment, and each appliance used—its form, structure, temper and tension, even to the last retainer. Yes, and even more, and far more serious than all of these, on the result of diagnosis must depend to no small extent the appearance and even the health of the patient for the rest of his life, for all our efforts make for the normal, which is health and beauty, or against the normal, which is the opposite of health and beauty, or deformity, for what is beauty but the absence of deformity? And last, in diagnosis is linked the very highest interest of the orthodontist—his reputation and ability—his very good name.

What could be more humiliating to a thoughtful, conscientious orthodontist than to daily encounter walking deformities of his own making? He may not often see them with the physical eye, but memory's vision

(Reprinted from Items of Interest)

he cannot darken. I can remember a few such cases most vividly—the result of unnecessary extraction from incorrect diagnosis—and they are the occasion of deep and lasting regrets.

If, then, diagnosis involves such responsibilities, what extreme care should the orthodontist give to it! How eagerly should he grasp every particle of knowledge that can give him light toward correct, intelligent diagnosis!

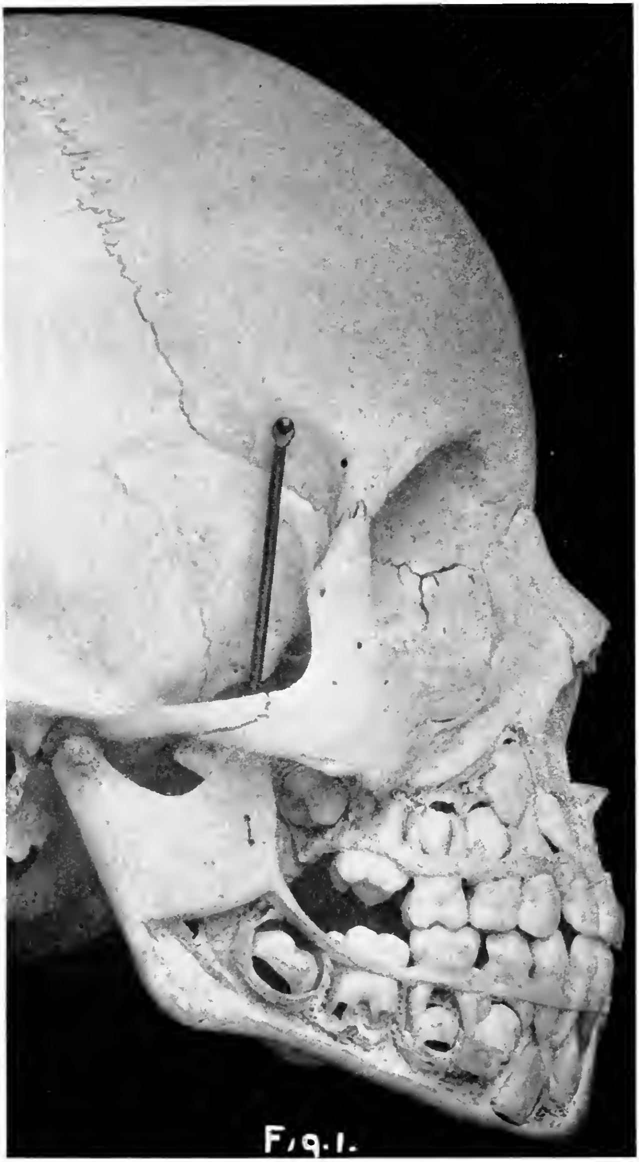
If there were but one type of face, how soon we would become familiar with its requirements—with its harmonies and all probable inharmonies, but we know there are no two faces alike—each patient so different in physique, in malocclusion and in art requirements; hence there has ever been great difficulty in making intelligent diagnoses of cases of malocclusion. The plan that has come down to us from its early dawn in the unfoldings of the science of orthodontia has been entirely empirical, depending wholly upon the judgment of the dentist. As there could be no definite aim nor end from such a principle there could be no definite result. Hence the result of such empirical methods has necessarily been widely differing and often most unfortunate plans of treatment. Now is there still no true principle to guide us toward a definite, intelligent decision—a correct diagnosis, so that we may start out intelligently on a course of treatment which we may follow logically toward a truly happy, successful end? Is it true that each person afflicted with malocclusion is so different from normal human beings—but "freaks of nature," or "degenerates," who must be dealt with according to the rule of "judgment" of the orthodontist, as writers of the old school would still have us believe? Has orthodontia, during all the marked progress that other branches of dental science have made, stood still, or at best only just emerged from the realm of superstition into that of conjecture—"guessing," for judgment, as usually manifested in orthodontia, is only a more dignified name for guessing.

Now judgment at best, as you all know, is a very variable commodity, even among the judges of the Supreme Court, and if you want a more marked example of its variability you can easily have it by passing a model of malocclusion around among the experts of the old school and getting their opinions as to diagnosis, and you will find that these various and very variable "judgments" are usually about as valuable helps in the real requirements of the case as would be some of Mother Goose's melodies for the same purpose. Dr. Ottolengui tried it and these various "judgments" are recorded in his journal. They make interesting reading. But among all the various and remarkable "judgments," on one point you will find they have usually agreed in the past from the

simplest case to the most complex, and that is that there must be some extractions, from a single tooth to even five, four premolars and a lower incisor, as advocated in the last writings of one of the "judges," as you will find in the July (1905) ITEMS OF INTEREST, and even then the writer complains that the mouth was still too prominent, which, being true, the wonder is that he did not keep on extracting in order to satisfy his "judgment." And another case is recorded in the last transactions of this Society where "judgment" required the sacrifice of six beautiful premolars and one fine first molar to reduce facial prominence, but without success.

Yet, notwithstanding that we still have "guessers" and "guessing" and "odontocides" linked together, one and inseparable, who juggle terms and meanings and furnish lots of evidence which won't bear sifting to explain the "guessing," with carefully devised loopholes as to meanings and dates and assertions, and will doubtless continue to have such with us for a long time to come; yet, I say, notwithstanding all this, we do have a simple principle to guide us to a correct, intelligent decision in diagnosis, which diagnosis is also a sure clue to a correct line of treatment, even to retention. A principle, too, whch eliminates "guessing," is antipodal to both "guessers" and "guessing." It is a principle, too, so simple that experts are not needed to understand and interpret it, but any sincere student, no matter how humble, with intelligence enough to master the English alphabet can understand this principle and apply it successfully in diagnosis, and this principle applies to every case of malocclusion in existence in a human denture to-day, or that ever did exist. Indeed, every case of malocclusion carries with it this principle which is a key to its own solution, its correct diagnosis, and that key is the key to occlusion—the first permanent molars, or more particularly, as I shall show you later, the *upper first permanent molars*. I repeat that this key is not for the "guesser" or the would-be improver of God's laws, but for the student of occlusion—the interpreter of Nature's great law in the human denture.

To the members of the new school of orthodontia this key is familiar and in daily, yes, hourly, use, and its great value attested, so that to you little need be here said. Yet in connection with it there are some points which I shall present that may be of interest to you, for, recently, in the preparation of the MS. for another edition of my book, I have gone over the entire subject of orthodontia, reasoning and weighing as carefully as I could all the points bearing on its various phases, and I believe that I can offer a few additional proofs why the upper first permanent molar is the correct basis for diagnosis.



You know our friends of the old school loudly proclaim that the first molar is so variable in regard to location as to make it utterly unsuitable as a basis from which to reason; that it is located, as it were, by chance, having no connection with the facial requirements, and is a mere will-o'-

the wisp which is in great danger of leading vast numbers of the younger members of the profession astray and to the committing of serious blunders with lasting regrets, as well as seriously handicapping the progress of orthodontia, etc., etc.

Now, if the upper first permanent molar were variable and unreliable as to its correct location, they would indeed be right and we would be wrong, but I shall try to prove to you that instead of varying so greatly from its correct location, it is, on the contrary, *if intelligently comprehended,* found to be in reality one of the most stable and unvarying points from a typal standpoint of our whole anatomy, therefore wholly trustworthy as a basis for diagnosis.

Eruption of the First Molar.

Let us study somewhat carefully this king of teeth which we have designated the "key of occlusion." Before the first molar erupts it is preceded by the completed denture of the child, which has developed normally under the most favorable conditions, for the food and habits of the child have been very simple and normal, with practically no pathological conditions sufficiently grave to prevent Nature from carrying out her plan of the normal in building the denture. So the deciduous teeth almost always erupt into ideal normal occlusion and the child denture is not only perfect in form, in part and in whole, but in location with the rest of the face and head, so that there is beauty, harmony and the highest efficiency. Dr. Anema has well said in connection with this thought, that the reason children's faces are in such perfect balance is because their teeth are in normal occlusion.

So, when the first molars erupt, they do so under the most favorable conditions, unhampered by predecessors or by those teeth anterior or posterior to them, the jaws having been lengthening for years for their coming, and instead of being in any way hindered in their eruption they are, on the contrary, *guided into and guarded in* normal position by the beautiful, normally built child denture anterior to them, as illustrated in Fig. 1.

The first molars have the largest crowns, best defined cusps, largest roots and strongest attachments to the alveolar process of any of the permanent teeth, and owing to their great size and their position in the jaws they are chief in the function of mastication. As the first molars are planted in the alveolar process long years before the permanent teeth, anterior and posterior, shall take their places in the line of occlusion, they have become very firm of attachment; so by their size and strength they can and do act as dictators of these teeth, and indirectly of all the other permanent teeth as they take their respective positions in the line of oc-

clusion at their respective times. They also act as wise rulers, determining by their own length the length of bite, and in this way, in no small degree, decide the length of the face and the art relations, which, in importance, is best illustrated—and in a striking manner—by what the face misses in after years when these teeth are sacrificed, allowing the settling together of the jaws and shortening of the face, with consequent inharmony of facial lines, always so noticeable, and their wise control of the

Fig. 2. (From the Collection of Dr. Chas. R. Turner.)

normal mesio-distal relations of the jaws by the locking of their well-defined cusps is a factor in the plan of growth and development of the face and jaws of mighty importance.

Up to the time of the coming of these teeth this important office was performed by the locking of the entire number of deciduous teeth, whose efficiency has been gradually lessened by the wearing away of their cusps and the otherwise weakening of these teeth by the absorption of their roots, but after the eruption of the four first permanent molars they must be not only the principal supports of the jaws and the controller of their lateral as well as mesio-distal relations for years, but on them, also, must

fall almost wholly the burden of mastication. I wonder how many of you comprehend and appreciate the important responsibility that the first molars assume in controlling the relation of the jaws, mesially and distally, as well as buccally, which has been transferred to them by the wearing smooth of the cusps of the deciduous teeth. Little indeed can be the assistance given by the permanent incisors during or even after their eruption, toward controlling the normal mesio-distal relations of the jaws, but if out of their normal positions they may and often do act as hindrances instead of helpmeets. Not until long years after the eruption of the first molars do they receive support and assistance from their weaker brothers, the premolars, and not until they have faithfully borne the great burden and responsibility during the most trying period in the growth of the denture for six long years do they receive that real support from the second molars which it would seem they have so long needed; but by this time the great structure is practically completed, there only remaining to be added the tardy, erratic and not very important last members of the family, the third molars. Fig. 2 shows the permanent denture completed.

What a grand and important part has been the work of the first molars in the building of the human denture. They have, as we have seen, been the very foundation, the supports, braces and very guides in the growth and development of this grand and beautiful structure, whose importance is only equal to its marvelous proportions and efficiency. The dental apparatus is the most complicated of any of the organs of the body, for the other organs, like the eye or the ear, are simple organs complete within themselves, while the dental apparatus is many organs combined. The different teeth, the lips, the cheeks, the tongue, the nose, the throat, the palate, all have functions in combination, as well as separately, and all have common and very important interests in growth and development, which is continued in harmony, each contributing to the beautiful balance of the whole, if normal, or any one may through disease disturb the balance of the whole and malocclusion may result—a perversion of the normal.

Occlusion.

In building the human denture nature has worked toward a definite end, to produce the most efficient parts with the most efficient arrangement of these parts, that they may in function be most efficient. And this type has been Nature's pattern for the human denture as long as man has been man and had need of teeth. So normal occlusion has not recently been discovered, but only recently applied to orthodontia by some, and apparently not yet either discovered or applied by some others. And right

here let me say that the coinage of far-fetched terms is unnecessary to express this beautiful condition of the teeth. It is perfectly expressed with just one word—occlusion (Ottolengui)—which always means the same thing, does not admit of juggling, and will henceforth stand out as the grandest word in dental literature.

That no two human dentures have ever been created that were exactly alike it is more than reasonable to suppose, since it has never yet been demonstrated that Nature ever duplicates her forms. No two trees of the same species have ever been alike; no two leaves on the same tree are ever just alike; no person's hand or foot, while of definite patterns, have ever been shaped exactly like those of any other person, nor have any two teeth of different persons, even of the same family, ever been counterparts one of the other. In every denture that Nature has ever created each tooth has differed from every other tooth of the same kind, and every dental arch has differed in size and form in a corresponding manner, just in the same degree that every other fiber and feature of every individual has differed from those of every other individual, yet blending in the whole into the greatest harmony possible to the *type* peculiar to the individual.

But these slight deviations from the general plan in individuals of species in trees, leaves, dentures, hands, feet, etc., are not abnormalities. They are nature and found in every department of nature, and the general form of the normal dental arches and the arrangement and placing of the different teeth with relation to each other in these arches—occlusion—is just as constant as the arrangement and placing of the five fingers on each hand and of the five toes on each foot. That there are occasionally six toes on one or both feet, or two thumbs on one hand does not alter the type of the normal foot or hand, nor does the appearance of supernumerary teeth, or the lack of teeth, or other dental abnormalities alter the type of the normal dental apparatus. So the criticism of Dr. Case that we are using a negro skull and not that of a Caucasian to typify the normal relations of the teeth—occlusion—seems trivial.

I have tried to make this point clear, for I am tired of hearing from men who ought to know better that there is no normal occlusion. I wish to make it plain that the permanent dental apparatus is, like the child denture, only a part of the type of the individual, and that it is always, in part, and in whole, and in location, harmonious with the rest of the head and anatomy and with the type, provided, of course, that the teeth are in normal occlusion, and I wish also to emphasize that in that case, no matter what the type (for Nature works in types), the mouth, so far as the teeth are concerned, will be in balance with the rest of the face. None of

you ever saw a face where the denture had developed with the teeth in normal occlusion in which the lines of the face were not in proper balance, at least so far as the teeth and jaws were concerned—the material to which our efforts for betterment are confined. If we are wrong and our critics right, why do they not show us well-authenticated cases? I do not believe such a case ever existed and I would go a long way to see one. How strange will this, one of their latest phrases, sound a few years hence: "In those cases where the upper molars have been inherited too far forward."

Influence of Type on the Dental Arches.

Each individual is then but a variation of some well-defined type, and no special type has a monopoly of harmony and beauty. The short, stocky individual with round head will be found to have a dental arch in perfect harmony with the individual—namely, a well-rounded arch and short, broad patterns of incisors, which, in size, correspond with the rest of his frame. If the individual is tall, slender and angular, with long, narrow face, the dental arch will be correspondingly narrow and long, with greater angle of inclination of incisors which will be of a longer and narrower pattern and also varying in size to be in harmony with the rest of the framework. Nature does not "use her judgment"—"guess" in these matters, nor make mistakes, but works in accordance with her wise, long-tried and well-established laws. She does not assemble individuals with one long leg inherited from one parent and one short leg inherited from the other parent, or with a long, narrow head inherited from one parent on a short neck and squatty body, with aldermanic stomach, inherited from the other parent. Neither does she make an equally grave and silly blunder, as our old-school friends still believe she does, as to force large teeth inherited from one parent into small jaws inherited from the other parent, thereby furnishing a tempting excuse and opportunity for the "odontocide." On the contrary, the offspring is like one of the parents or the other or both or neither, but different from both, as individuals have ever been, but with teeth and jaws and legs and faces and bodies in harmony with its type, just as its parents' teeth and jaws and heads and legs are in harmony with their individual types. And this is not limited to the Caucasian race, but applies to the offspring of man of all races and in all ages.

Is it not remarkable that Nature should blunder in the relative sizes of the jaws and teeth in the permanent denture so often and never commit this same blunder in the baby denture, and would it not be just as reasonable to expect it of her in the one set as in the other, and is not the evidence just as conclusive in the one case as in the other?

Indian Types.

I shall show you some Indian pictures (Figs. 3, 4, 5, 6 and 7) from slides kindly loaned me a few days ago by that great artist and student of Indians, Mr. E. S. Curtis, of Seattle, Wash., and in these pictures you will see the truth as to balance of the jaws with the rest of the anatomy just as clearly as it is exemplified in your own individual cases or in those of your children. I regret that I cannot show the occlusion of the teeth of these Indians, but as they are fine and sturdy specimens of their race which is noted for good teeth, it is reasonable to suppose they have all of their teeth, and that they are in normal occlusion is evident to all of you from the beautiful harmony of proportion of the mouth with the rest of the face.

One of the most remarkable of many remarkable statements made by one of the writers of the old school recently, is that the face may be so thin that to place the teeth in normal occlusion would be to deform the rest of the face by making the cheeks bulge out too much. Think of it! Think of a human being having a face so thin that an arch of average normal width, say two and a quarter inches, would bulge his face out of proportion!

But seriously, would it not be well for our old-school friends to furnish proof for some of their remarkable statements—real proof which could, if necessary, be investigated? Orthodontia has reached a stage, I think, when facts are really what are needed and not mere statements. And I am proud to say that the new school in its reports of cases, produces facts in the shape of fine reproductions of truthful models of life size or even larger (so that the occlusion can be easily studied), as well as fine photographs of faces and the entire head, not pictures of fragments of heads or microscopical pictures of models of the teeth which are practically worthless as evidence.

Variations from Normal.

So far, I have spoken only of the normal, for it is only by knowing the normal that we can have any conception of the abnormal. It seems to me that one great trouble with our critics is that they study malocclusion from the abnormal only and naturally get confused as to real facts, as well as to the solution of facts. Now we know that malocclusion of the teeth is but the gradual perversion of the normal during the eruption and locking of the teeth, and that this is due largely to simple mechanical means, for we have all watched its growth in all its various forms, from its simplest beginnings to its most complex forms, through all its possible three great classes with their natural divisions and subdivisions. We know every case has a simple beginning in its variation from the normal, and that very often a single tooth, from slight cause,

being deflected from the normal, may and usually does involve others. The dividing line, then, between the normal and the abnormal in the beginning is very slight, but always clearly defined, so the normal in occlusion is the only logical basis for determining the variation and extent of the abnormal—malocclusion. Very naturally, then, the treatment of malocclusion would be toward the normal, after first, of course, removing the cause; not assuming wisdom sufficient to improve on the plan of Nature, but beginning each case as early or as near the beginning of its

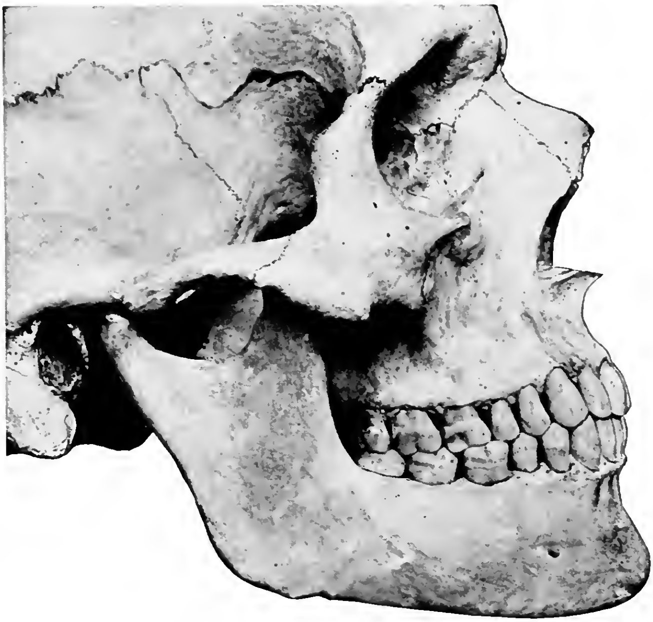


Fig. 8. (Cryer Collection.)

deviation from the normal as possible and simply assisting Nature in her plan in carrying out the normal. Then we will have the normal in result—normal in the number of teeth, normal in occlusion, normal in balance of proportion and in facial lines to be in harmony with the individual type—the greatest efficiency, the highest attainable beauty *for that type.*

Naturally, then, for the very wisest of reasons we use the first molar as a basis for our diagnosis, for, as we have seen, it is Nature's very corner-stone in the building of the structure (the denture), and we have noted with what zealous care as to time and place Nature, the great architect of the type, placed that corner-stone that the parts of the denture

might be, when completed, not only in perfect harmony with the whole denture, but with the rest of the head and even the entire anatomy, just as she has been careful in the placing of other important parts of the head, as for example, the sphenoid bone, the eye, or the ear, that when all was completed they would be in harmony with the whole.

Influence of Type on First Molar.

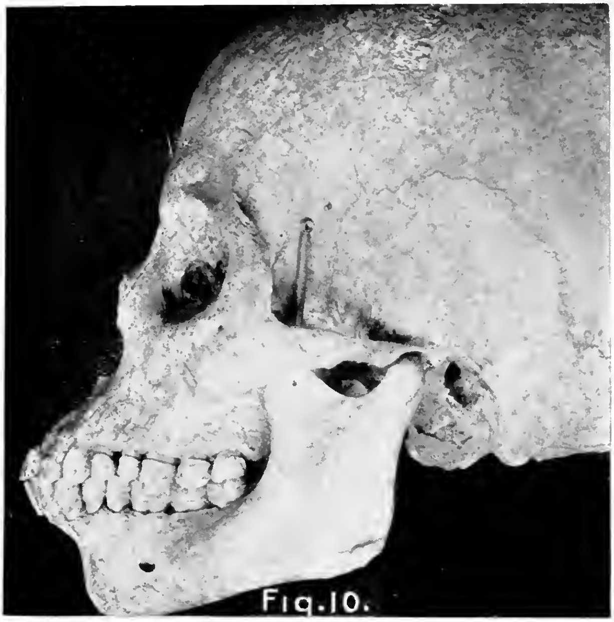
That we find the upper molar to vary mesially or distally in its location with the rest of the skull in different races, tribes and individuals according to type is not surprising to men who have any knowledge of comparative anatomy.

Fig. 9. (Broomell Collection.)

I will place on the screen a few pictures that you have seen used again and again in the dental journals recently by some of our critics of the old school in an effort to prove the unreliability of occlusion as the basis of diagnosis on account of the great variability in location of the first molars, and let us study them. Our critics have not been content with ordinary examples which we all daily see, but have gone to the uttermost parts of the earth in order to show the most pronounced types of variation; hence variability, and for this I am not sorry, for we want our position gauged with the strongest tests. Let us study these cases carefully and we will be able to read another story from that which our critics would have us read, and we will see that they not only fail to prove their point, but give us the strongest of proofs of the correctness of our

own position—namely, the correctness of the location of the first molars according to race, type or individual, and more, of the typal patterns of teeth, and size and form of dental arches.

Let us compare the three skulls (Figs. 8, 9 and 10), which these pictures represent (Figs. 8, 10, 11 and 12 were kindly loaned me by my friend, Dr. Cryer, the author of the greatest of modern works on dental anatomy). First, we have the normal or best example of the normal in occlusion, so say our critics, and for the time being let us grant this, for



(Cryer Collection.)

it is a beautiful skull and the teeth are in beautiful occlusion and the plan of normal occlusion is beautifully shown. Let us note the type of individual which this skull represents—the straight line of the profile and general fine balance. It is said to be the skull of a Caucasian—probably an intelligent one, and please note the location of the first upper molars and their relation to the rest of the skull—how far distally they are placed, the upper third molar being partially hidden behind the ascending ramus. From the size and form of tooth patterns we may assume that it belonged to an individual of medium height and size and probably of regular proportions.

Let us examine the picture of the second skull and denture, which, our critics say, is all wrong, because, they say, it is that of a negro and the teeth protrude too much. I say the teeth are more beautiful in pattern and more normal in occlusion than in the other skull, for the compensating curve of occlusion is almost straight in the first and normal in this, which is something of no small importance, and there is equally good proportion of balance and proportion of the teeth, denture and skull in this type as in the last skull with its type, and please note especially

Fig. 11. (Cryer Collection.)

the location of the first upper molar and how much farther forward it is in its location in relation to the skull than in the last picture, and how necessary, yet natural, that it be farther forward to be in harmony with the negro type, for it is said that this is a negro skull. And yet the negro type does not necessarily *always* mean the prognathous type, for I think we have all seen negroes with quite a straight profile line.

Now, note the third picture, one clear to the extreme in the type of man, the very lowest in the scale, one of the Fan Tribe of negroes, so low indeed that we may call him a beast man. But even in this most extraordinary type I think we still see with equal truth and clearness Nature's beautiful plan of normal occlusion, and of facial balance with type, as we did in Fig. 8 or Fig. 9. Let us remember that this man was close to the animal in habit, instincts, brain, body and type; probably knew just enough to eat, fight and reproduce his kind, and his skull and denture are in perfect accord with such a being. Look at his brain box. It is less in size than an intelligent child's should be at one year of age. He is just animal, and how clearly does the animal show, yet who dares say that in life this man with these bones clothed in wool and healthy

muscles was not as normal an example of his tribe, or that his facial balance was less perfect for his type than these same bones and organs are for the respective types of our critics or of ourselves, or of that of the skull first shown? And who cannot see that every tooth is here needed and is in harmony with every other tooth, and that to destroy a single

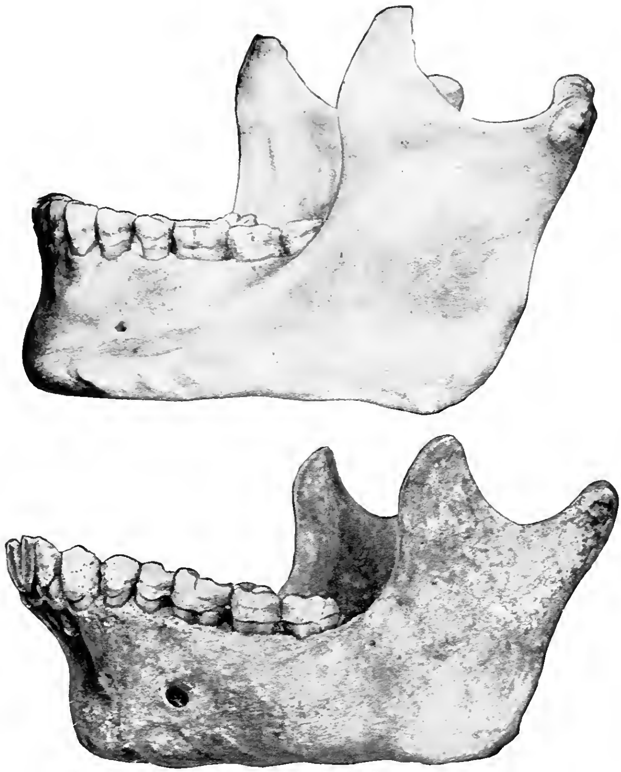


Fig. 12. (Cryer Collection.)

tooth would be to destroy the harmony and beauty of the whole? And please note the location of the first molars, how much farther forward they are than in that shown in Fig. 8 or even in Fig. 9, and why not? Yes, why not? The skull of the pug dog is vastly different from that of the beautiful greyhound, but is not each in perfect harmony with the type, habit and instincts of each individual dog?

Fig. 11 shows another view of the same skull shown in Fig. 10, from the occlusal aspect of the teeth and base of skull. It is placed beside a Caucasian skull from the same aspect. This, of course, our critics

have used to show the marvelous difference—the great extremes in the teeth and forms of the arches, and to prove the variability of the position of the first molars, and consequently to accentuate their unreliability as a basis of diagnosis. Fig. 12 shows the mandibles of these two skulls and the same wonderful difference is here, also, clearly manifest.

Now, if I had looked the world over I think I could not have found anything more fitting as proof of the harmony of proportion and balance of parts as related to types and the correctness of my own position than


Fig.13.

(Angle Collection.)

is shown in these last two pictures. Note the broad, short and very round skull of the one, and how beautifully the arch harmonizes as to form and size with that skull (and I have no doubt the whole type of the individual was in perfect accord with his skull), while with the other, note the extremely long and narrow base of the skull, with the animal development tremendously prominent in the back part of the skull, and note also the long, narrow dental arch, and how beautifully its proportion harmonizes with its type. Who can say which arch is the more perfect in its relation to the skull to which it belongs?

Let us now go further with the criticism of our critics than they have gone, and notice a fourth skull (Fig. 13) from my own collection, that of one of the anthropoid apes, and we will see the same beautiful principles of occlusion, the same beautiful accuracy of variation according to the habits and instincts of the animal and his type. And it would be just as wise to extract five of this brute's teeth and drag his incisors

toward his throat in the effort to make beautiful or even to improve his facial lines, as it would for his far-removed relatives, our critics, to treat their patients in the same way for the same purpose. And please note the location of *these* first molars and also how long and narrow is his dental arch.

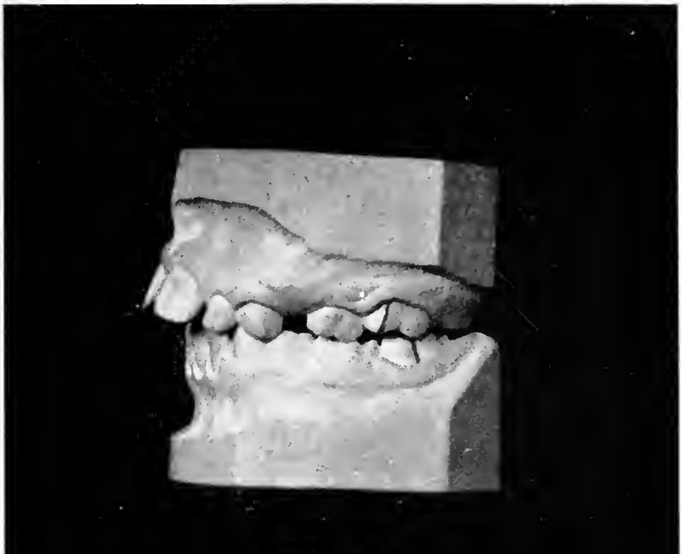


Fig. 14.

In the lemur, which is still lower, these variations, according to type, are carried still further, and yet with the harmony of balance unbroken.

Mesial Position of Molar Explained.

Another criticism of some of the oracles of the old school is that the first molars are inherited in a position farther forward than normal, or that they are found farther mesially than normal on account of premature loss of the deciduous teeth—more "guessing" instead of reasoning, for practically never are they inherited farther mesially than normal unless in freaks, and their mesial position as a result of mutilation of the deciduous teeth is but temporary. Now this is what does happen. If the first molar does move forward into the space of the deciduous second molar it does precisely, though *prematurely,* what it would do and must do ultimately in the growth of the jaws and denture

in order to permit the second and even third molars to take their positions in the line of occlusion. So it would finally not be abnormally placed, but those teeth of the permanent set anterior to it would most probably suffer as to position as they erupted and tried to gain position in the line of occlusion, for the reason that the alveolar process would not have been normally stretched in anticipation of their coming on account of the deciduous teeth being gradually carried mesially by the eruption of the permanent molars, as they would be had not the deciduous molar been removed.

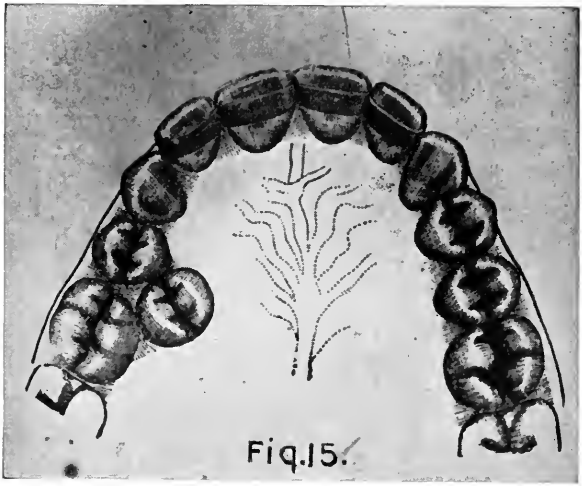


Fig. 14—a cut kindly loaned me by Dr. Lourie—shows such a case as the one in question. The lower molar is made to lock in distal occlusion by reason of the premature mesial movement of the upper, and the distal movement, to some extent, doubtless, of both the lower molar and the mandible.

It is easy to realize what will take place later on the eruption of the bicuspids. Fig. 15 shows such a case, and probably there is no one here who has not seen similar cases, but you can readily see that the molar is not mesial to its normal position, although it took this position prematurely, just as the first molar, as shown in the last picture, is now in process of doing. I have seen many such cases and never one that I can now recall where the first permanent upper molar had been made to travel mesially to its final normal position. Dr. Ketcham has shown me a slide representing a similar case to-day, and doubtless you all have models representing similar conditions.

Beauty versus Usefulness.

And here is another criticism coming from two of the eminent members of the old school last heard from, although I cannot believe this opinion is shared by any considerable number of them. It is to this effect: That we of the new school do wrong in placing efficiency of the teeth before beauty, instead of making beauty the goal to be sought for in treatment, as they do. Now think of it! Was the dental apparatus made principally for the adornment of the face, and incidentally, possibly, to eat with? Not in all living nature, either plant or animal, can I recall a single instance where utility in an organ is not placed before ornament. Even in the most beautiful flowers beauty is only a means to an end. The birds of gayest plumage are not made deficient in beak that they may be given fine feathers for selection in mating and the reproduction of their kind. Then why should so very important an organ as the dental apparatus in man be mutilated in the false notion that his beauty is thereby enhanced, when in man beauty is not essential to procreation nor to his intellectual capacity, and at best is feeble and fleeting? Now, in reality, with the new school, beauty and the highest efficiency go hand in hand, and when we have fulfilled our mission by helping nature to complete the normal in type we will have, incidentally, the greatest beauty possible as the result of our skill.

But why note such criticisms further when there are so many problems of great value to the orthodontist to be carefully and patiently weighed and balanced before orthodontia is universally recognized, as it must and will be—the grandest and most important work relating to the human teeth than any one can or will engage in.

So far in what I have said relating to the first molar the upper and lower have been regarded as of equal importance, as they should be, for in function of mastication they are equal, as well as in influence upon the rest of the dental apparatus during its growth and development, and they should be of equal importance in diagnosis, *but only when they succeed in locking normally* in their mesio-distal relations. But owing to the fact that the lower molar is dependent upon the caprices of the migratory mandible, it is in consequence less reliable than its sturdy, though somewhat smaller, but far more steadfast antagonist. For this reason the upper first permanent molar becomes the true basis of diagnosis.

Discussion.

Dr. F. M. Casto, Cleveland, Ohio.

The paper which Dr. Angle has just presented treats of a subject of very great importance. His position regarding the upper first molars is shown beyond the question of a doubt. The lucid and specific manner in which he has presented the subject signifies two things: First, that his conclusions are based upon both scientific research and the observation of a great many practical cases; second, that he does not intend to be misunderstood.

We all recognize that in order to properly classify and intelligently diagnose cases of mal-occlusion, we must have some fixed point which is constant in its relation to the bones of the face. I mean, of course, as constant as any anatomical structure can be. Dr. Angle claims the upper first molars represent such a fixed point. He gives us logical reasons why it is so, and presents numerous documents to substantiate his claims, and I believe him. If I did not, I would practically be compelled to denounce his classification of mal-occlusion.

The members of the so-styled old school condemned this classification because of their claim of the unstability of the upper arch in its relation to the physiognomy, saying that in one case it might be placed too far anteriorly, while in another it might be too far posteriorly, yet the occlusal relations would be the same in each. That is to say, by viewing the models of such cases the occlusion of the teeth would be in the same relative position mesio-distally. These men have also woefully misunderstood the classification, so far as the upper first molars are concerned, from a diagnostic standpoint. Only recently an article was published in one of our leading journals in which the statement was made that we of the new school claimed specifically that whenever the upper first molars erupted in a normal position mal-occlusion of the teeth would not, nor could not occur in the completed denture; that to have these teeth (upper first molars) in a normal position is entirely incompatible with any mal-occlusion. We do not make any such claim at all. The first molars may, or may not, be in a normal position in the "Class 1" cases of mal-occlusion, but they must be in a normal mesio-distal relation to the lower first molars. I think the writer of that article was confused by the statement in one of our text-books to the effect that the entire arrangement and occlusion of the dental arches are determined by the eruption of the lower second bicuspids. If they erupted normally there would be no mal-occlusion, if abnormally there would be mal-occlusion.

I have observed a few cases of mal-occlusion in the temporary teeth, cases in which the mesio-distal relation was abnormal. I have at the

present time a case under my observation in which at the time of the complete eruption of the temporary teeth there was inclined to be a distal occlusion of the lower arch. The mandible was underdeveloped. The lower molars did not erupt until several months after the upper molars had erupted. I notice at the present time, it having been about ten months since the denture was completed, that the mandible has developed more in proportion to the upper jaw, and the distal tendency is being corrected. The mesio-distal relation now is practically normal. Consequently I believe that the mandible does not develop as rapidly as the upper jaw in some cases, and therefore there is a tendency to distal displacement of the lower arch, which may be corrected at the age of five or six years, after more development of the mandible has taken place. Of course, if development be retarded until the first permanent molars erupt, and firmly lock the occlusion, then that is another proposition altogether.

From what we know and understand about the development of the jaws and process, and especially that which pertains to the forward movement of the arches for the accommodation of the second and third molars, Dr. Angle's position in regard to the mesial displacement of the upper first molars, when due to the premature loss of the upper temporary molars, is indeed well founded. I understand his claim is this: That the mesial movement of the permanent upper first molar, due to the loss of the temporary second molar, is only premature; that in the completed denture it (the first molar) will occupy the same position as when the temporary molar had remained intact the required length of time, or until it had been supplanted by the second bicuspid; that is to say, the normal forward movement of the arches would move the first molar mesially to the position it now prematurely occupies. For example, let us assume that we have a case in which at the age of eight years the second temporary molar on the right side had been lost, and the first permanent molar had shifted mesially from its normal position. On the left side the temporary teeth had all been normally retained, and lost. Now in this case Dr. Angle claims that at the age of sixteen or eighteen years the upper first molars on both sides will be in a normal relation with the balance of the bones of the face, but that there will be a lack of development of the jaw anterior to the first molar on the side where the temporary molar had been prematurely lost. I think he is right. I know he is right unless the present theory of development can be overthrown. He does not say, however, that it is absolutely impossible to have a condition in which the upper first molars are too far mesially, but concedes that there may be some such cases, although extremely rare.

Fig. 1.

Fig. 2.

Fig. 3.

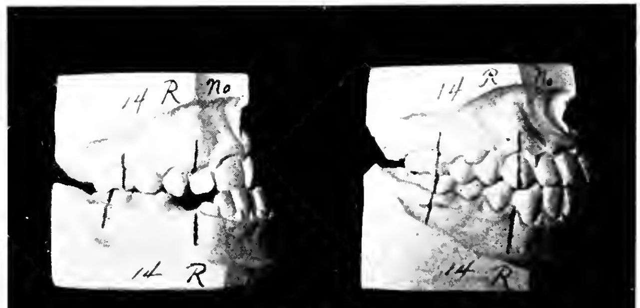


Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7

Fig. 8.

I have a case of mal-occlusion with me to-day, which I desire to present, in which I believe it was absolutely necessary to move the upper molars distally in order to get the best results, and I think the following pictures will prove to you that it is one of the exceptional cases of which the Doctor speaks.

Case from Practice.

The case belongs to Class II, Division II, and is somewhat unusual, in that it is characterized by a bi-lateral distal occlusion of the lower arch, the upper incisors being in lingual occlusion to the lower incisors, and the patient being a mouth breather with practically normal development of the mandible. (Figs. 1 and 2, models on left side.) The face presented the characteristic appearance of a Class III case, in which the lower arch is in mesial occlusion to the upper arch. (Figs. 5 and 6.) According to my diagnosis the case presented the following forms of mal-occlusion:

First. Bi-lateral distal occlusion of the lower arch.

Second. Imperfect alignment and lingual inclination of the lower incisors.

Third. Lower cuspids erupting in torso occlusion.

Fourth. Contracted and shortened upper arch.

Fifth. Torso-lingual occlusion of the upper incisors. The lateral incisors were almost in contact with the first bicuspids, thus closing the spaces for the permanent cuspids.

Sixth. Torso-occlusion of the upper first bicuspids.

The shortening of the upper arch was most likely due to the premature loss of some of the temporary teeth, allowing the upper molars and bicuspids to move mesially from normal, and the incisors to move lingually.

The treatment consisted in moving the upper molars and bicuspids distally about the width of a bicuspid. Expansion of the upper arch. Labial movement of the upper incisors. Rotation of all the teeth in torso-occlusion. Moving the lower incisors labially to overcome their lingual inclination, and to provide space for their rotation.

The upper molars and bicuspids were moved distally, instead of shifting the occlusion by moving the lower arch mesially, because there was a prominence of the lower jaw, and the facial lines would not permit of any forward movement.

The models on the left of Figs. 1, 2, 3 and 4 show the case in the beginning; those on the right side the completed case. I consider that almost ideal results have been obtained, both in occlusion and facial harmony. I do not believe the face would permit any more prominence of the mouth, making due allowance for the future development and the

enlargement of the features. Figs. 5, 6, 7 and 8 are pictures before and after treatment. Age of patients, eleven and thirteen years respectively.

A most important factor in this case was the child's health. Because of the severe mal-occlusion of the teeth thorough mastication was made impossible; therefore the food was not properly prepared for its entrance into the stomach, and as a result indigestion followed, and the patient suffered from mal-nutrition. This, together with the baneful influence following continuous mouth breathing, made the child almost a physical wreck. The family physician had informed the parents that the boy was undoubtedly tubercular, and advised that he be removed from the detrimental influences of this climate to one more suited to his condition. They were arranging to go to New Mexico with him when I was first consulted. I am happy to state that after two years' treatment in the way of orthodontia and an operation for the removal of adenoids, thereby establishing normal occlusion and normal breathing, the patient presents a healthy condition, both physically and mentally. All evidence of a tubercular trouble has disappeared.

Dr. C. A. Hawley, Columbus, Ohio.

I feel some embarrassment in being called upon to discuss such a paper as this, containing as it does propositions that have undoubtedly been the result of long study and careful observation. It is a paper which seems unworthy of anything but the most thoughtful consideration, and what I have to say must be mainly in the way of expressing my appreciation and admiration for the comprehensive and scientific treatment of the subject. Concerning classification and diagnosis, Dr. Angle, in this paper, has not at all overestimated its value and importance, and it is due to his work that we have any good working classification at all. The position that the writer takes, that the first molar invariably comes into the proper position, if established, strengthens very materially his claims in regard to the value of his classification.

The main proposition is one that at first, without more time to consider and observe, I am inclined to doubt. We know that first molars are found moved mesial to their proper position, either on one or both sides. Now whether they are farther forward than they will eventually move in the full development of the denture, I am not prepared to say, and I do not believe one could offer an opinion without considerable observation made with relation to that especial point.

In view of the fact that the cuspid teeth, though often apparently out of place, will generally be found to have forced other teeth out of the way to take their normal position, it seems reasonable to think that the first molars coming in more unhampered by obstacles in the way would

invariably take the proper place. That proper place must be judged with the particular race and type of individual in full consideration. We have a great deal to learn about faces. You cannot make faces conform to a fixed standard, and you cannot make many faces beautiful, but probably we can assist greatly to perfect the type which Nature intended for a particular individual. In the different races Nature has certainly placed the first molar in the proper place to develop the race type. I would not want to say that she is not as wise in regard to the individual.

This is a paper to think over and study. Its conclusions were not arrived at hastily, but are evidently the result of much observation. I believe in the main they are true, and a few exceptions would not alter the chief argument of the paper.

Dr. Milton T. Watson, Detroit, Mich.

The position of the upper first molar is a subject which interests me vitally. I am not yet convinced of the accuracy of Dr. Angle's deductions as he has presented them to us to-day, but if I am wrong, and it can be made clear to me, I shall be only too glad to change my views. It would simplify matters immensely for us if we knew that the upper first molars always erupted in correct mesio-distal relation to the face, for we would then know, beyond question, the exact requirements of the case; as the matter now stands men sometimes differ on this point.

If it could be proven that this particular tooth is always in correct mesio-distal relation to the skull, the fact would still remain that the development of the face is so influenced by pronounced cases of mal-occlusion, even of Class I, that unless the correction is undertaken at a comparatively early age we will never be able to develop the face to the extent that it would have developed naturally if unhampered by the conditions causing the mal-occlusion. It is at this very point that the advocates of extraction make their most serious mistake. They are afraid of marring the facial line by making the lips too prominent, so they remove one or more teeth and thus lose, to their patients, the many advantages of an increased nasal capacity, which would have resulted from the enlargement of the jaws and the retention of all the teeth. If there is really danger of the lips being too prominent, move the molars distally.

In the correction of cases of the first division of Class II, I take it that Dr. Angle would *confine* the movement in the molar and bicuspid region entirely to the lower teeth; for if the upper molars erupt in their normal mesio-distal relation to the face, that would be the natural treatment. Now, I have at times treated cases of the first division of Class II where I would not have dared to resort to such practice.

It is especially difficult for me to believe that we should base our treatment of all cases of Class III upon the reliability of the position of the upper first molars. I believe that it would be infinitely wiser for us to make a careful study of the artistic requirements of these patients, and then as a result of this study decide whether we will establish occlusion by confining the movement, as nearly as possible, to teeth of one arch, or whether we will endeavor to bring about a reciprocal movement, which shall be controlled according to the requirement of the case.

Dr. Angle himself does not question the fact that the upper first molars erupt lingually to the normal line of occlusion; yet he would have us believe that even the premature loss of a second deciduous molar would not allow this tooth to come forward of its normal position, but that the teeth in front of it would simply fail to be pushed forward sufficiently. He has taken great pains to convince us of the truth of his convictions, but it happens to be one of those questions that cannot be absolutely proven. It is perhaps quite as difficult to disprove, though we all admit the fact that these upper first molars are frequently out of position bucco-lingually together with the fact that I have seen a first molar almost in contact with a cuspid, and its relation to the lower teeth and to the profile showed conclusively that in this case, at any rate, the molar had moved forward too far. This is certainly strong evidence.* I have seen fully developed cases of both the second and third classes when only the deciduous teeth were present, and surely in such cases as these we could not expect to find the first upper molars erupting exactly in their correct mesio-distal relation to the skull and face.

If Dr. Angle could sustain his contentions regarding the reliability of these teeth it would indeed be a marvelous discovery, for nowhere else in all nature, so far as we know, is there an organ which is always normal in any single phase of its functions or anatomy. Seriously, gentlemen, it hardly seems within the realm of reason to expect so much of these teeth. I am thoroughly in accord with Dr. Angle's earlier views, which were, in effect, that the upper first molar and cuspid are the most reliable of any of the teeth in the mouth, but farther than that we cannot go, I think.

I have examined carefully the model belonging to Dr. Lourie, which Dr. Angle showed on the screen, and in this particular case he is possibly right. My own unbiased opinion was that the upper molar, particularly on the one side, had tipped forward at a slight angle.

I have for several years been greatly interested in the relation of malocclusion to the development of the face, both externally and internally,

* Dr. F. A. Bogue shows a model on page 767 International Dental Journal 1905, where even a second upper molar is almost in contact with the cuspid.

and I am becoming more and more convinced that the bone proper of both the maxilla and mandible is influenced by pronounced mal-occlusion. It is but natural to suppose that Nature provides a base, or foundation, in proportion to the growing superstructures, and, consequently, the large well-developed dental arch, which has become such unaided, is associated with a face and jaws in every way more completely developed. The point I am working toward is this: the cases where deciduous molars, for instance, are lost early, and where the upper first molar moves forward without causing the forward movement of the teeth in front of it, is a type of case in which the internal face is not well developed. Therefore, if correction is attempted after about sixteen years of age we must remember that we are developing the dental arch to its normal degree, while the structures beyond and even those influenced by the roots of the teeth will not take on a normal development after about that age.

Dr. Varney E. Barnes, Cleveland, Ohio. I have listened to this paper with a good deal of pleasure, and I can agree with a good many things in it. The talk on harmony has been delightful, and I think it is right, but some of the things have struck me as not being quite the sort of matter we want to send out as representing our society.

In the first place, take the use of the terms, "old school" and "new school." It is like putting a chip on your shoulder and expecting somebody to come around and knock it off, looking for a fight. Let us follow the idea of the word "occlusion." If we wish to have the word "occlusion" mean what is normal, let us use that word occlusion, and not the words "normal occlusion." Let us go a little further and follow that same idea out. If we are going to correct teeth by putting them in occlusion, if we are going to believe what has been quoted in this program, "occlusion is the basis of the science of orthodontia," let us be orthodontists; let us be what the term orthodontia means. Let us speak of ourselves as orthodontists, and not as of the "new school." If you want to speak of a man who does not put teeth in the proper relation, call him a "regulator" or a "dentist"; he is not an orthodontist. Let us not antagonize others by saying we are of the new school and know so much better than others.

I would like to ask Dr. Angle a question. Does he mean to say that in cases where the upper first molars move forward mesially they are inclined, or that they move forward? From the cast shown on the screen I should say that that tooth is inclined forward, that the tips of the roots are in their right relations. Now don't misunderstand me to mean that I think that just tilting that tooth backward and bringing the

lower jaw forward will correct this trouble, because I don't. I think, with Dr. Angle, that the first upper permanent molar is close enough in a standard relation so that you can judge by it. I would say that I believe that the first upper molar is nearer correct than the lower, and I believe that is as far as you can go.

I do not believe that we have any arbitrary standard. The man who chases an arbitrary standard is chasing a will-o'-the-wisp. It is so all through everything in this universe. It is like the absolute zero—it is a point upon which to base calculations, but for practical use we have zero, and we make our calculations accordingly.

Now, as to the temporary teeth, I believe it is largely a question of environment, and I believe hereditary influences will have, as you may say, a good deal to do with it. I have one family under treatment—three girls. All three of them showed great irregularity in the temporary teeth. I have watched those cases and watched them develop in the temporary teeth, as Dr. Hawley suggested, but they seemed to grow worse. I find that I can diagnose a Class II and Class III case in the temporary teeth every time. Now, this may mean only for the Lake regions. I believe the men who are in the Lake regions meet a harder type of cases than are found elsewhere. Nearly everybody has them. I find the children who are presented to me with their temporary teeth frequently have those teeth in mal-occlusion, so that I cannot agree with Dr. Angle on that. And I wish again to go on record as saying that I believe that the upper molar cannot be taken as a standard. It is very close to it perhaps in many cases. We very often have tried to move it forward too far, but I believe you get the indication when to stop by the resistance that you meet.

Dr. A. H. Ketcham, Denver, Col.

It has given me great pleasure to listen to this masterly presentation of the claims of the first permanent molar for recognition as the greatest and most unvariable tooth in the permanent denture. It is inconceivable that any fair-minded, scientific orthodontist could dispute its paramount value as a basis of diagnosis. There are those who have criticised us for using a negro skull to show normal occlusion. I think that their criticism must be due to a misunderstanding of our position, which is that this particular skull shows a beautiful occlusion, with the teeth and the alveolar process in the best positions to give facial harmony in this face and in this type, but not for all people, nor even for all negro faces, because, as we who observe faces carefully know, we sometimes see the face of a negro as straight as any of the Caucasian race. Last year I noticed the same thing in some faces among the Moros and among

the Indians at the World's Fair. Their profiles were as straight as any of ours, their types demanding this.

But we of the new school know, and those of the old school will yet learn, that no matter how far forward the teeth and the alveolar process may be placed upon the maxillary bones, and no matter how far back they may be placed, all the teeth must be present and in occlusion to secure Nature's intended best harmony in the features of that particular type.

Had some of our critics understood the importance of the first permanent molar in diagnosis we would not have had the lamentable results which were shown in the Second District Society in Brooklyn, and which were reported in the August (1905) Items of Interest from Dr. Guilford's paper; and others equally bad, reported in the July (1905) Items of Interest, from Dr. Case's paper. Dr. Guilford is evidently not familiar with the normal occlusal positions of the first molar, and in several of his slides which showed the occlusion he did not call attention to the fact that the lower arches were in distal occlusion, and said that "expanding the upper would make it too large for the lower," which, of course, would be true if accomplished without moving the lower forward.

Dr. Angle spoke of a photograph of a patient which I have. After talking with Dr. Angle last evening it occurred to me that I had a photograph of a case similar to the one which he showed of the palatal aspect of the upper arch. This was a case with the second bicuspid in lingual position, which was later extracted by the dentist. I have seen the original models with the teeth in occlusion, and later I made models from plaster impressions, and, as you will see, the upper molar is in its proper mesio-distal relation to the lower; the teeth on the opposite side of the mouth are also in proper mesio-distal relations, but the teeth anterior to the missing upper second bicuspid have not been pushed forward by the molar, and are in distal positions, so that the face, to the casual observer, has the appearance of a Class III case. The second temporary molar must have been lost prematurely.

If I understand Dr. Angle correctly, the first permanent molar erupted in normal position and relation with its opposing first molar, but on account of the loss of the second temporary molar the first upper permanent molar, being deprived of mesial resistance, moved prematurely forward into its ultimate correct position, but, of course, without exercising Nature's usual normal force (on account of the loss of the second temporary molar) in pushing the remaining deciduous teeth forward. and thus normally stretching or lengthening that lateral half of the upper jaw, and so providing the normal space for the eruption of the bicuspids

when they should later attempt to erupt. In other words, the first permanent molar having prematurely taken its correct position without assisting in lengthening the jaw, those permanent teeth anterior to it were, without proper space, forced to be bunched in their eruption, the second bicuspid being forced to take a lingual position to the line of occlusion, which seems to me the only thing that could result under such conditions. I therefore see no reason for taking any exception to the position Dr. Angle has taken, and those who oppose him must certainly fail to comprehend the normal forces in the building of the dental apparatus and how they would naturally be modified when deprived of the normal wedging influence by the loss of one or more of the deciduous teeth prematurely. My own case proves this exactly, and I have no doubt that every one of you have seen or will see similar cases if you will only interpret them correctly.

Dr. William J. Brady, Iowa City, Iowa.

I feel I must express my appreciation of this painstaking paper from Dr. Angle, and say that although for the past year we have been too busy to write to each other, yet there must have been some vein of communication between St. Louis and Iowa City just the same, for I have been doing some independent work along this same line, and have been led to exactly the same conclusions, although our work has been very different, mine being investigations in comparative anatomy upon the skulls of the lower animals as well as man.

It would seem that the matter presented by Dr. Angle must have been running in the minds of us all, for even in the criticisms offered we see that men have been thinking on this subject. Unless a man thinks he cannot express a definite opinion about anything, and whether he thinks right or wrong is not so important as the fact that he thinks at all; he will think right in time if he only keeps up his thinking. So for the benefit of those who have been thinking—and let us hope will continue thinking—I will give a few results of my investigations.

First, there is no absolutely fixed point from which the development of the cranium can be gauged, either in the animal man or any other. The nearest to a fixed point is the anterior margin of the foramen magnum, the place used by zoologists generally as the starting point for all cranial measures and comparisons.

Second, the next nearest fixed point is the placement of the principal grinding tooth of the superior maxillary. This is a premolar in some animals and a molar in others; it is the first molar in the case of man. Examination shows that the relation of this tooth to the rest of the cranium is very constant throughout all the animals of a certain species

or type, the relation, of course, varying with each type, but remaining practically constant for all animals of a kind. This fact applies to man the same as the rest.

This is a fact of great importance to us as orthodontists, for it is the only constant point that we can examine at all. We cannot kill our patients just to find out where the anterior margin of the foramen magnum is, hence we must take the next best thing within our reach.

The question next naturally arises, what places this important tooth —or any other teeth, for that matter—in any certain position, and why should this one be so unvarying in place? I believe the answer has never been given before, or, if so, has never been made as prominent as it should.

The time of development of the different teeth should be recalled, when it is seen that the more important the tooth the earlier its development begins. I can speak with certainty in the case of but very few of the lower animals, but in the case of man more or less of the crowns of the temporary teeth and of the permanent first molar are developed and placed in their positions before birth, without the action of ordinary outside influences. Their development is governed entirely by the action of heredity, whose influence placed those same teeth in the same positions for countless generations before us, and will continue to place them exactly the same for countless generations after us. The nearer we reach the beginning of anything, whether tissue, organ, or what not, the more it is governed by the action of heredity and the more it is exactly alike in development in all specimens.

The action of heredity is the chief if not the only controlling force that settles the positions of the teeth named, and they are so placed that when they erupt they have only to emerge through the tissues covering them when they are in their correct places. This is why the temporary teeth are always practically regular, which fact is one of the best established in relation to the teeth. The gentlemen who have told of finding from fifteen to twenty per cent. of mal-occlusion in these teeth have been carried away by their enthusiasm, and while I have no doubt they think they are right, yet they are mistaken. An estimate of mal-occlusion cannot safely be given from a limited number of cases; they must be examined by the thousands to form any just conclusion, and when these gentlemen have done this they will revise their figures and put the percentage very small, as it should be.

The first molar is the only tooth of the permanent set to be developed and settled in position before birth, and its relationship to the rest of the teeth and to the cranium is remarkably constant, undoubtedly from the action of heredity, as has been explained. All the others are developed

later in life and subject more to the influence of health, disease, nutrition, exercise and growth and development in general. The first molar is erupted early, while development is usually very active, and from all these causes has the best chance of any of the permanent teeth to find a correct placement. If abnormality of location occurs—as it does at times—the reason therefor is usually so plain as to admit of exact calculation of the correct position of the tooth, and this point Dr. Angle especially emphasized, but it has been overlooked or misinterpreted in the discussion.

It is on this very point that Dr. Angle has been subjected to the most criticism, all of which has come from a misunderstanding of his meaning, though I must say that it looks as though some of his critics have not tried very hard to understand him. He has never at any time taught that the first molars are invariably found in the proper place, but has maintained that Nature is very constant in correctly placing them, and that any malposition thereof can almost always be accounted for by some simple cause, and the correct position calculated, and this teaching is certainly correct.

There should be no difference of opinion in this matter, or at least it should not take the form of criticism of the paper from a misunderstanding or misinterpretation of its statements. Such proceedings are unscientific, the thing we especially wish to avoid. There should be no question between any of us at all over this, for I think we practically all believe the same thing, and we have lost sight of the main question, and are discussing mere differences of expression.

The differences of opinion lead me to feel that we are not yet familiar enough with the development of face, jaws and teeth. We cannot fully understand the presence of the abnormal till we comprehend the origin of the normal. We cannot master such problems as this one till we have traced the development of every bone of the cranium from its beginning to its completion, when we can see what Nature intends to perform and can understand what really occurs when it fails to reach the intended end. We will be at sea on many things till such study has been made.

I wish finally to say to Dr. Angle that though the years are passing he is not growing old. When he begins to really grow old, his faculties will commence to decline, but this paper shows that as yet they are on the increase, and that age has not left its imprint upon him, and may the time be long in coming when it does.

Dr. J. Lowe Young, New York. I am very much interested in the subject to which we have been listening, and I must say, very, very much surprised.

I believe there is a vast difference between guessing and judgment. I believe that a man who uses the best judgment he possesses based on experience is entirely different from the man who has absolutely no conception of the subject which he is trying to handle, and simply blunders here and there—and once in a while any fool strikes something correctly. That man, I say, is guessing.

Dr. Angle. Define the difference. What is judgment and what is guessing?

Dr. Young. Judgment is that mental attribute which enables us to arrive at conclusions after weighing evidence or reviewing experiences.

Guessing is an attempt to attain the results of judgment without weighing evidence or reviewing experiences.

If I understand the writer, he makes this assertion: that the upper first molar invariably takes its normal position in relation to the rest of the skull on eruption. I want to go on record as saying that I do not believe that one is ever so developed. Now gentlemen, do not misunderstand me. I refer not only to the mesio-distal position of this molar, but also to its bucco-lingual position.

Dr. Angle takes it for granted that the deciduous teeth are usually in occlusion, but this I cannot accept. What are the principal causes of mal-occlusion? I think there are two great causes: First, I will put lack of use; second, pathological conditions in the nasal cavity and the upper respiratory tract. Do we not have lack of use in the deciduous teeth? We certainly do.

I further believe that fifty per cent. of all second class cases have their beginning prior to the eruption of the first permanent molars, and that the earlier such cases are treated, the better will be the final results.

The picture of the little Indian baby that was shown on the screen, such a beautiful chubby faced little thing, had no signs of lack of development. I promise you that this child from the time he could hold his hand to his mouth was chewing some tough old substance that the old squaw gave him, and was developing muscles to masticate and bone to sustain his teeth, while our city, milk-sop babies got nothing of the kind. Consequently there is lack of development from lack of use.

If this lack of development is very pronounced and is allowed to continue till the age of fifteen, it is very questionable that facial harmony can ever be restored by the most skilful treatment of the teeth. As an

example, take twins: they are so much alike that nobody can tell them apart but the mother, and one of them is shut up in a little apartment here in Chicago, breathing this smoky air, and the other goes to live with her grandmother in Colorado, breathing clear, fresh mountain air and getting pure, fresh milk to drink. The one has a puny, pinched-up physiognomy and the whole organism is dwarfed owing to the environment. The little sister that the father could not tell from the other when they separated in Chicago fourteen years ago, has developed into a strong, healthy child with almost normal occlusion. Do you mean to tell me that by expanding the arches of this undeveloped Chicago girl so as to put all the teeth, which have the same mesio-distal diameters as those of her twin sister in normal occlusion, or in occlusion, I will accept the term, that we will not have a bulging out of the cheeks owing to the positions of these teeth? The earlier such correction is made, the greater chance there is for the rest of the bones of the face and head to develop. But will that develop the whole anatomy? I say it will not.

Now, I would like the slide of the set of models that Dr. Angle threw on the screen, if you can find it, the models of Dr. Lourie's case. (Fig. 14 in Dr. Angle's paper.) Dr. Angle said that this apparent movement mesially of the first permanent molar was not a genuine mesial movement, and that the locking of these cusps had crowded the lower jaw back. Now, gentlemen—

Dr. Angle. I beg to differ with you. I never said that the first permanent molar had not moved forward.

Dr. Young. I wrote it down just as you said it, my dear man, right after you.

Dr. Angle. The models show conclusively that the upper molar had moved forward.

Dr. Young. Yes, but you said that the lower arch was crowded back—not arch, but jaw, that is what you said.

Dr. Angle. I have not the least idea but that it is crowded back some, but how much, I do not know.

Dr. Young. That is all right; if you claim it is crowded back at all, that is all I want.

I have examined these models carefully, and there is absolutely no space between the deciduous molar and the first permanent molar. Now, then, if that whole jaw is crowded back, where is it being crowded to? The condyle of the mandible, I claim, can be crowded back only as much as you can absorb the cartilage in that cavity, and I believe that has not been done in a case like this. I cannot accept

the statement. Furthermore, I find that in this set of models you did not have occlusion on the other side, but it was an end to end antagonism, and while the lower arch needs bringing forward, that is, the lower teeth need bringing forward some, the upper first molar on this side should be carried back. If this statement that Dr. Angle has made is true, I will never again try to treat a third class case.

Dr. Angle. I realize that you have all been pretty well inoculated with my humble effort, so probably we may better close it. I regret, however, that the paper has not been discussed broadly. It seems the points I wished to impress you with most, namely, the constant normal position of the upper first permanent molar, according to type, a few of you have failed to comprehend, and have gone rampant on a minor point which really is an afterthought in the paper, and that, too, without understanding it. Such discussions would be well in the usual dental society, but they are not in keeping with the aims, objects and character of this society. In my opinion men have no right to discuss a paper without first comprehending it, otherwise such discussions can only fall far short of possibilities in intended good.

You are still being taught by the few remaining relics of the old school that the first molars are quite as likely to be too far mesially or distally as they are to be normal; hence we must depend for diagnosis on judgment of the facial lines, and it is hard to get erroneous ideas that we have grown up with out of our systems. This is clearly proven by some of your discussions. I have tried to prove to you what I have thoroughly proven to myself after a large observation—that the first permanent upper molars are wonderfully constant as to normal location; that they are practically never inherited in positions mesial to normal and only assume that position as a result of mutilation, especially of the permanent teeth anterior to them, and that even then their mesial variation will be found far less than any of you will perhaps believe until you have yourselves examined a large number of mutilated cases, and you will also find that any variation can be easily detected. Of course I do not refer to those cases we frequently meet where the first molars have been dragged forward by faulty methods of regulating, usually following mutilation, but even in those cases the molars when released from mechanical restraint of the regulating appliances will show a wonderful tendency to find their normal positions.

Those who listened carefully to my paper know that I intended to lay down no inflexible rule, but only one which is, I believe, the nearest to an inflexible rule that we have as a basis to reason from in the diagnosis of cases of mal-occlusion.

We have frequently heard in this discussion, "I do not believe" this, and "I do not believe" that. This seems out of place in the arguments of men who are seeking truth. In reality it matters not whether you do believe or do not believe. It is only what can be proven that can or should have any weight among scientific men. Now, if you will bring good and valid proofs for the grounds of your disbeliefs to our next meeting, if it is better evidence than I have offered or am able to offer in substantiation of my position, I will gladly acknowledge that I am wrong and that you are right in our respective deductions. Naturally I am not surprised that some of you should differ with me in my deduc-

Fig. 16.

tions on some points, but if these differences will only stimulate you to observe carefully and repeatedly along the line I have brought out, I feel quite sure you will not differ so radically with me a few years hence.

There have been some quite remarkable statements made. For example, you have all heard Dr. Young say that he did not believe the upper first molar ever erupted into normal position. Such statements, of course, need no answer. They are only the product of inexperience and lack of observation. He will talk differently when he is not so very new in orthodontia.

Statements have also been made in regard to the deciduous teeth which I think are contrary to the general belief, namely, that a large percentage of deciduous teeth, twenty-five per cent., I think some one said, erupt in mal-occlusion. My own observation leads me to believe the percentage is far less, but any mere statement one way or the other is entirely worthless without the recorded facts derived from observation

of a large number of cases before we could have anything like a correct basis for an opinion.

In regard to the remarks of Dr. Barnes, very little need be said when we remember his education in orthodontia. He came from the old school, is of the old school, and naturally winces when we are compelled to speak of those who still preach antiquated doctrines as the "old school."

Dr. Watson has told us of a case where the first molar was in contact with the cuspid. I have no doubt that in such a remarkable and rare case the first upper molar has moved mesially from its normal position somewhat—probably as the result of bad orthodontia. Fig. 16 shows one of that class of cases from my own collection, and, I think, a very pronounced type. I could show you several of the same kind, though less pronounced, and yet in this case, when carefully studied, it will be found that in reality the upper first molar is probably but very slightly mesial to its normal position, and this notwithstanding the fact that far less than the usual normal resistance has been given by Nature to prevent its moving forward, for in this case the germs of both upper premolars on this side are missing. Only the permanent cuspid developed, while the deciduous cuspid is only held by the gum, the root being almost wholly absorbed.

On superficial observation you would naturally be led to believe that the fault is in the molar region, while in reality it is anterior to the molar region, the alveolar process and jaw in the premolar region having failed to develop properly because there was no stimulus from the teeth to promote their development.

Dr. Watson has also said that in the treatment of cases belonging to the first division of Class II that if the upper molars are in correct position mesio-distally, then the simple "jumping of the bite," according to Kingsley, would be the correct plan of treatment, but that he has treated scores of cases where to follow this plan of treatment would be out of the question, as it would make the lower part of the face too prominent. Now this may be true, although that is a large number of cases, and if the Doctor will show us at our next meeting good models and good photographs to prove his statement, even in a half dozen cases, I will be much surprised. I will say that in my life's work I truly cannot recall a single case belonging to this division of this class, unaccompanied by mutilation, where the first upper molars were mesial to their normal positions. Now one very strong proof of the correctness of this is that in these cases all your common observation, as well as all the pictures representing these cases, show that the lower jaw is shorter than normal—an undeveloped mandible—giving the well-known weak and receding chin which the

caricaturist so often utilizes, and if Dr. Watson has had scores of cases with normal sized mandible, yet with teeth in distal occlusion, he must have a class of patients differing greatly from those of the rest of us.

Now why would we move the upper molars distally if they are in their normal positions in these cases? Simply to do the best we can to strike a balance between the normal in the upper jaw and the abnormal in the lower. If it were practicable to "jump the bite" instead of the occlusion only, we would in every case of this kind that I have ever seen come the nearest to the ideal in establishing facial requirements, but we now know, at least some of us think we do, that what really does take place when we "jump the bite" and maintain the normal locking of the cusps long enough for this occlusion to become permanent, is that in reality the mandible gradually slides back to its original or approximately original position and relation with the skull, the crowns of the upper teeth having been tipped more or less distally, while those of the lower jaw have been tipped mesially, so that in reality we have accomplished, after many months of difficult retention, merely the jumping of the occlusion, or what we now aim to accomplish and do accomplish easily in a few weeks by means of the Baker anchorage. Yet this is not the ideal, but is the best we can probably do; hence the importance of jumping the occlusion as early as possible, hoping and believing that the normal relations of the teeth will stimulate and tend toward the normal growth of the mandible, and this principle and result will hold good quite as well in the third class as in the second.

Here is a statement which may surprise you. I have yet to see one of these cases where we did move the upper molars distally, together with the teeth anterior to them, that it did not show proportionately detrimentally in the contour of the upper lip, yet the compromise, as I have said, with the lower is perhaps the best we can ever do.

Now whether the deciduous teeth are locked in mesial or distal occlusion in one case or in many cases in a thousand it matters little in the question under discussion. If the development of the jaws and the deciduous teeth is normal, the latter will be in normal occlusion, and will make possible the normal eruption and locking of the first permanent molars, as I have shown you. But if they are locked abnormally, or in mesial or distal occlusion, through adenoids or from any other cause (and the wonder is, considering how commonly and how early in childhood adenoids attack the post-nasal tract, that we do not find more cases of mal-occlusion of the deciduous teeth), it only means that this is not the rule, that it is abnormal, and that it will probably make impossible the normal locking of the permanent first molars unless the cusps of the deciduous teeth should be worn so smooth from abrasion that the first

permanent molars might, and doubtless do in many cases, succeed in groping their way into normal locking. The safe rule would be, I think, to correct the mal-positions of the deciduous teeth as a greater safeguard for the normal locking of the first permanent molars, as has been so beautifully and effectually done in one of these cases by Dr. Mendell. The case is to be later shown upon the screen at this meeting—the youngest case so far treated.

Dr. Watson has further said that we often find the first upper molar in lingual or buccal occlusion, and since this is so, why should we not with equal reason expect to find it mesial or distal to its normal position? To my mind there is no parallel between the conditions. In the first instance these teeth are actually forced buccally or lingually by the irresistible force of the jaws acting through the inclined occlusal planes, but I would like to ask what force there is to move the upper molars forward other than that of the normal force of the erupting second and third molars, and after they have so acted and succeeded in locating the first molars what could possibly cause their further migration? I can readily understand how they would be prevented from moving forward through the force of the lips acting on them indirectly through the anterior teeth, but I know of no power operative in moving them forward.

I am very much obliged for the kindly remarks relative to my paper and especially am I gratified with the masterly discussion of Dr. Brady. That is the kind of reasoning I like to hear. He has carried you deeper into the subject than I have attempted, and the deeper we go the more convincing the evidence in favor of the constancy of the position of the first molar according to type.

So positive am I of the correctness of the position I have taken to-day that I feel sure it will only be a little while until we hear some of our critics make their usual well-known statement, "Why, certainly; we have always believed that and have been teaching it all over the country for years."

I sincerely hope and believe that the discussion will have so stirred us all up that in the end we will be much benefited, and the majesty and importance of the upper first permanent molar be better appreciated.

Let me again say in closing, bring proof—plenty of it—in the form of good models and good pictures, to our next meeting. In this way much good will result from this discussion. I have no fear but that the mechanical in orthodontia will take care of itself, for most men seem unable to go beyond the mere mechanical, but I do have fears that many of you are not giving as much thought to the purely scientific phases of orthodontia as you should, and it is the problems of science relating to our specialty that these meetings should earnestly strive to investigate.

A Few Thoughts Concerning the Teeth and Their Osseous Base.

By Richard Summa, D.D.S., St. Louis, Mo.

Orthodontia, perhaps more than any other department of dental science, attracts our attention to the relation existing between the teeth and their osseous base. The influence exerted by one of these upon the other is so intimately reciprocal, that many times it becomes practically impossible to discriminate between cause and effect. Any reference to the growth of an organ must begin with a consideration of the structural units or cells of which all bodies, both animal and plants, are composed. *"Omnis cellula e cellula."* Wilson credits the origin of this aphorism to Virchow's doctrine that every cell is the offspring of a pre-existing parent cell. This suggests that every organ owes its existence to a transmitted germ, and hence the frequently abused theme of inheritance.

Theories of Heredity.

The human mind since time immemorial has cherished the mysterious and apparently supernatural. A reason for this may be found in the comfort and self-satisfaction derived from laying all good things and more especially all things bad and indifferent, at the threshold of some occult being or force.

Heredity, it is true, is one of the problems of nature which the human mind may never be able to solve completely. This apprehension should not lessen our desire for truth, but on the contrary it should stimu-

late us to approach this question with the same unprejudiced consideration and logic which has tended to restrict so many mysteries of the past.

Great consolation has been derived from the dictum of the inheritance of the small jaws of one parent and the large teeth of the other. It has served its time faithfully as a convenient subterfuge whenever difficulties occurred in the correction of so-called irregularities of the teeth.

When speaking of inheritance, it is but reasonable that we should ever be mindful of the significance attached to this term by biologists.

Perhaps the oldest theory which has gained any prominence is the "Theory of Preformation," with which the name of Bonnet is so intimately connected. It considered the egg as containing a miniature of the parent body. Accordingly, every organ is preformed and further development is but an enlargement of that which already existed. This would offer a very simple explanation of inheritance.

In 1759 Frederick Caspar Wolff demonstrated that the egg does not contain a preformed body. He considered the egg as a homogeneous structure which under the influence of some special force passes through different developmental stages resulting in a heterogeneous organism. This is known as the theory of "Epigenesis."

Almost a century later Darwin offered his theory of "Pangenesis." "According to this hypothesis, every unit or cell of the body throws oft gemmules or undeveloped atoms, which are transmitted to the offspring of both sexes and are multiplied by self-division. They may remain undeveloped during the early years of life or during successive generations and their development into units or cells like those from which they were derived depends on their affinity for union with other units or cells previously developed in the due order of growth."

Next in order might be considered Naegeli's "Idioplasm Theory," which assumed that inheritance is effected by the transmission not of a cell considered as a whole, but of a particular substance, the idioplasm, contained within a cell and forming the physical basis of inheritance. This idioplasm was conceived as an extremely complex substance consisting of elementary complexes of molecules known as *micellae.* (Wilson.)

It should be noted that none of these authors had located the vital units. Not until about 1874, following the investigations of Auerbach, Fol, Buetschli and a little later those of Oscar Hertwig, Strasburger, Van Beneden, Koelliker and Weismann concerning the mechanism of development and the part played by the cell in hereditary transmission, was the conclusion reached that the chromatin of the nucleus contains the physical basis of inheritance.

Hertwig arrived at the conclusion that the germ nucleus is equally derived from both sexes; the cytoplasm, that protoplasmic substance which surrounds the nucleus, is derived from the female sex only and most probably furnishes the nutrition for the developing organism.

The theory of Weismann, "The Modern Evolution Theory," assumes that the germ-plasm is composed of a large number of different vital units, each of which bears a definite relation to certain cells of which the developing organism is composed. A group of these vital units he terms biophore; a group of biophores, determinants, because they determine certain parts of the organism; a group of these ultra-microscopic determinants he named id. The component parts of an id are said to possess the power of attraction and repulsion (vital affinities) to which growth by means of indirect cell-division is attributed.

Instead of a division of the egg into predetermined cells, Hertwig in his theory of Biogenesis assumes that all such cells are carriers of all characters of the species. Their specialization is due to the various internal and external influences.

Professor Hugo DeVries, the Dutch botanist, formulated the theory known as "Intracellular Pangenesis." Concerning this Wilson writes:—"The neo-pangenesis of DeVries differs from Darwin's hypothesis in one very important respect. Darwin assumed that the gemmules arose in the body, being thrown off as germs by the individual tissue-cells, transported to the germ-cells, and there accumulated as in a reservoir; and he thus endeavored to explain the transmission of acquired characters. DeVries on the other hand, denies such a transport from cell to cell, maintaining that the pangens arise or pre-exist in the germ-cell, and those of the tissue-cells are derived from this source by cell-division."

Even a more thorough consideration of these theories of inheritance than the time allotted to my discourse would permit, can but suggest that within the germ cell, most probably within the nucleus, there exist vital units which are designed to produce specialized cells and these in turn are the units of the various organs of plants and animals. These vital units have been variously named: gemmules, micellae, biophores, idioblasts, pangens, etc.

The nucleo-plasm of the female germ cell and of the male germ cell are the carriers of the characters of the parents, therefore only that which is transmitted to the offspring through the germ-plasm can be regarded as inherited.

Prof. J. Orth writes: "The words inherited and congenital are often used synonymously, but there is no justification for it because, although everything inherited is also congenital, it does not necessarily follow that

everything congenital is inherited. The opposite to inherited is acquired. Acquisitions are either extra-uterine or intra-uterine; if intra-uterine, they are congenital but not necessarily inherited."

Transmission of Acquired Characters.

We must now consider the much discussed question of the transmission of acquired characters. According to the hypotheses of inheritance which I have previously enumerated it appears that all biologists agree that every transmissible character is expressed in the germ-plasm. Therefore to transmit any acquired character it becomes essential that such acquired formation be promptly recorded in the germ-plasm. We know that not all conditions which justly come under this caption are transmitted to the offspring, and consequently a distinction between transmittable and non-transmittable acquired characters would be of great value. This, however, seems to offer the great difficulty.

The clearest distinction I have been able to find in my study and one that harmonizes with the various theories is among the writings of Orth: "Qualities which are derived from the continuity of the germ-plasma are inherited and hereditarily transmissible.

"What has arisen through primary variation of the germ-plasma and appeared for the first time in the offspring, is acquired indirectly and can also be transmitted hereditarily.

"That which produces a secondary but adequate variation in the germ-plasma after having appeared first in the soma (body) of the same generation is acquired and hereditarily transmissible.

"Acquired conditions of the soma which do not produce an adequate variation in the germ-plasma can not possibly be transmitted. This seems to apply to all mutilations of external and superficial parts."

Weismann, especially, expresses a most serious doubt as to the possibility of the transmission of acquired characters because of the necessity of recording these characters in the germ-plasma. The same author ascribes the apparent transmission of acquired diseases rather to an infection of the germ-plasma than to any change within the germ-plasma.

Relation of Heredity to Tooth Forms.

While we have under consideration the transmission of characters of the teeth acquired by an animal during its life time I wish to submit the following argument of Tomes:—"But even if we grant the one much disputed point, namely, that characters acquired by the individual during its own life time can be transmitted to its offspring, there is a special difficulty remaining in the case of the teeth in adopting the simple mechanical explanation that the teeth are, so to speak,

drawn out of their forms, whether in one or in ten thousand generations. For, unlike the bone, which is constantly growing and being renewed after it has come into use, that portion of the tooth which is subject to these direct influences is hard and rigid, and its form, whatever it be, in that individual is unalterable; in order to alter the form of the masticating surface by direct mechanical means, it would seem that the influence must be brought to bear upon the teeth while they are yet soft, when they are still buried within the jaw in their bony crypts. And we can not safely assume that structures like enamel covered dentin can be altered by pressure, the essential character of dentin being its elasticity, and that of enamel its rigidity. It therefore follows that the tooth is of a nature very little likely to be deformed, or being deformed, to retain its deformity."

Before passing this subject I would like to call special attention to the plausible suggestion as to the difficulty of explaining the transmission of acquired characters of an organ so insusceptible to external influences as the fully developed tooth.

Transmission of Characters.

Qualities derived from the continuity of the germ-plasm establish that structure of an organ which has been selected through generations as best adapted to the performance of the function for which it is designed. These qualities establish the normality of an organ and it is but reasonable to assume that the reproduction of these qualities is the inherent tendency to transmission. *From this it follows that the inherited germ tends to reproduce an organ primarily indicative of the genus from which it comes and only secondarily bearing the stamp of its immediate ancestors.*

Applying the preceding principles to the organs which interest us more particularly, we must subscribe to the statement of Walkhoff that the final shape of the mandible results from the influence of the muscles of mastication and speech and the growth, use and loss of the teeth upon an inherited germ. To these must be added the influence of the difference in atmospheric pressure within and from without the oral cavity produced by the harmonious action of the muscles of the cheeks, lips and tongue.

For the sake of lucidness we might sum up the factors involved in the development and growth of the jaws as follows:—

1. "A transmitted germ possessed of an inherent tendency to reproduce an organ adapted to readily resume the function most frequently exercised by the ancestor."—Walkhoff.

2. Development, growth, eruption and function of the teeth.

3. Influence of the muscles of cheeks, lips and tongue by virtue of their tension and the difference in atmospheric pressure from within and from without the oral cavity produced by their activity.

We may say that the first factor I have mentioned is responsible for the existence of the organ; whereas the latter two, external agencies, are responsible for its development.

It is, indeed, difficult to decide as to the relative importance of factors each of which is designed to perform a duty so peculiar to itself that none can take the place of the other, while the influence of all are necessary to attain a certain result.

It seems to me but logical to assume that the germs transmitted for the jaws and teeth in any given case tend to reproduce jaws and teeth primarily indicative of the genus to which the parents belong, and only secondarily impress upon these organs the variations and transmissible acquired characters of the more immediate ancestors. Therefore we expect to find in man jaws and teeth peculiar to the genus "homo" and varying within certain limits according to racial and family characteristics.

That the jaws and teeth are located in a certain part of the face; that the teeth are composed of certain structures; that they occur in certain numbers and forms and in a certain approximal and occlusal contact no one will deny. And these are, at least, some of the qualities which establish the normality of these organs. The relatively slight variations which they present in size, color, form and in the different degrees of physiological prognathism of the arches are the stamps of race and family type.

The Teachings of Comparative Embryology.

While inquiring into the part played by the teeth in the development of the jaws, it is of interest to consider some of the teachings of comparative embryology and anatomy. Tomes writes: "If the growth of the dogfish be followed, those spines of the skin which cover the jaws become developed to a far greater size than those outside; a groove without spines appears between the jaw and lip, and the identity and continuity of the two become to some extent masked. No one can doubt, whether from the comparison of adult forms or from a study of the development of the parts, that the teeth of the shark correspond to the teeth of other fish, and these again to those of reptiles and mammals; it may be clearly demonstrated that the teeth of the shark are nothing more than highly developed spines of the skin, and therefore we infer that all teeth bear a similar relation to the skin. This is what is meant when teeth are called 'dermal appendages,' and are said to be perfectly distinct from the internal bony skeleton of the animal; the teeth of the shark (and of many other creatures) are not only developed, but always remain imbedded in tough mucous membrane, and never acquire

any connection with bone. Indeed all teeth alike are developed from a part of the mucous membrane, and any connection which they may ultimately get with the bone is a secondary matter."

I have often read this chapter by one of the best authorities. It would not be surprising if it formed the basis for the belief expressed so frequently that teeth and jaws of higher types of animals also develop and grow quite independently of one another. The expression that "teeth are highly developed spines of the skin" no doubt added to the confusion, many taking this to mean that the most important dental tissue, the enamel, is an epidermal structure derived from the epiblast. At least one author of a chapter on orthodontia explained the inheritance of the large teeth of one parent and the small jaws of the other by the naive assumption that in such cases the epiblastic structures are derived from one parent and the mesoblastic structures from the other.

I feel quite confident that such suggestions are misinterpretations. When speaking more definitely Tomes and Hertwig use the expression "dermal appendages" which implies that the most important dental tissues are derived from the derm or corium which originates, as does all connective tissue (including bone), from the mesoblast or, more particularly speaking, from the mesenchyme. Therefore bone and the most important dental tissues, the dentin and cementum, are embryogenetically related. Hertwig has made the interesting observation that in many amphibia the vomer and palate bones result from the confluence of small bony plates which have formed around the base of the teeth. Just a little careful observation must convince any one that the osseous base upon which teeth are carried is subservient to these. *To my mind the study of this question offers a strong suggestion that the tooth is the initiative for the existence of the calcified jaw.* According to Walkhoff the rapidly growing dental papilla, which is also responsible for the eruption of the tooth, compresses the fibers of the spongy bone surrounding the tooth-germ into compact bone. This observation gives us the first inkling of the effect of the growing tooth upon the adjacent osseous tissue.

Formation of the Jaws.

Of almost equal importance to the continued growth of the jaws are the muscles of the cheeks, lips and tongue. The mandible, especially, is influenced by the muscles inserted in it. The pressure and tension which they exercise varies according to the occlusion of the teeth. Thus one possessing a full complement of teeth in normal occlusion would instinctively employ these muscles to produce different excursions of the mandible during the act of mastication than one who has an impaired occlusion. Dr. Walkhoff* who has made a very thorough study of this ques-

* Walkhoff.—Der menschliche Unterkiefer im Lichte der Entwickelungsmechanik. Id.—Der Unterkiefer der Anthropomorphen und des Menschen.

tion, employed the X-ray to ascertain the arrangement of the inner structure of the mandible of man and the anthropoid apes. He found that the originally irregularly deposited spongy structure of the ramus becomes arranged into a system of fibers called a trajectory already during embryonic life. At birth there exists such a trajectory which extends in a straight line from the condyle to the symphisis. Soon thereafter this straight trajectory becomes bent immediately behind the alveolar process. This is caused by the growth of the teeth and the development of the alveolar process and becomes more marked as new teeth assume their function. A little later new trajectories are formed in consequence of and corresponding to the function of the muscles of mastication and of speech. It is impossible to report the results of his investigation in detail, suffice it to state at this time, that Walkhoff demonstrates conclusively the powerful and ever present influence of muscular tension and pressure upon the inner as well as superficial structure of the mandible.

We must bear in mind that the mandible is held in a state of equilibrium by the muscles inserted in it; that by a contraction of certain groups of these muscles the various movements are produced and that when the mouth is closed the mandible is held at rest by suction which is nothing but a difference in atmospheric pressure* from within and without the oral cavity.

The pressure of the tongue is a factor of equal importance in the development of either dental arch.

Muscular tension and pressure upon the superior maxillae is not as great as in case of the mandible because the muscles inserted in it serve functions less apt to influence bone formation. Although the pressure and tension of the muscles of the cheeks and lips (muscles of expression) is a factor not to be minimized, yet I believe that in the moulding of the upper arch atmospheric pressure is of greater importance.

Study of Crowded Arches.

It has also been urged that the frequent occurrence of crowded teeth among civilized races indicates nature's plan of a further reduction of the size of the jaws. This brings us to a consideration of the creation of species and varieties by the adaptation of organs or parts of organs to new environments. This is another problem which has aroused animated controversies among biologists. Perhaps the majority are of the opinion that varieties and species are produced gradually by selec-

* The Influence of Atmospheric Pressure in Molding the Dental Arches.—Dr. F. Zeliska.—Proceedings of the Fourth Int. Dental Cong.

tion of those qualities which serve the present conditions best; others under the leadership of DeVries do not believe that new species are the result of gradually increased "individual variations." According to their belief new species are the result of sudden changes which they call *"mutations"* in contradistinction to "variations" which, being brought about gradually, are fluctuating and do not produce new species.

Granting, for sake of argument, that nature plans in thus reducing the size of the jaws and that mutations are not simply inexplicable happenings, the mode of reduction suggested by the crowding of teeth prompts a few questions.

First, does the reduction of the size of the jaws precede the reduction of the teeth?

Second, if teeth are to be eliminated in consequence of a previous reduction of the size of the jaws, are they eliminated by being crowded out of alignment?

Third, if some teeth must be eliminated is that to be accomplished so unsystematically that different teeth are crowded out of alignment in different cases as though nature were constantly experimenting to find the easiest object of attack?

We assume that the ancestors of civilized man of the present day were of the prognathous type, such as we still meet in the lower human races. It is customary and plausible to attribute this prognathism to the prehension of food, a function no longer exercised by civilized man.

The reduction of this physiological prognathism to the present orthognathism was not accomplished by crowding teeth out of alignment promiscuously. It is possible that teeth were reduced in size, but the most striking change we are able to observe, has been the receding of the dental arch upon the body of the jaw. This condition has been pointed out by several authors and especially by Dr. Cryer. While the occlusal relations of the dental arches are identical in both the prognathous and orthognathous types, in the former the third molars are anterior to the ramus while in the latter the third molars are partially obscured by the ramus. This backward movement of the dental arches is doubtless the cause of the dwarfing of the third molar. Thus the gradual dwarfing of an organ prior to its total elimination from the animal body is again substantiated.

It is generally accepted that use of an organ increases and disuse diminishes its power of assimilation. This principle holds good in every struggle for existence. The survival of the fittest takes place whenever and wherever conflicting interests exist between different genera, species, varieties, individuals, different organs of the same individual, different tissues of an organ, different cells of a tissue and if we accept the germ-

plasm as consisting of a system of vital units it is but logical to assume that the same struggle goes on there.

Weismann expresses the opinion that degeneration, which all organs undergo prior to their elimination, begins in the final stages of an organ and is only gradually reflected in the embryogenic stages.

As has been previously stated, only those characters which have produced an adequate change in the germ-plasm after having first appeared in the soma (body) are hereditarily transmissible. In other words, in order to pronounce any peculiarity of teeth an inherited acquired character, such a character must at first have appeared in the teeth of the parent (most probably as the result of environment); and secondarily it must have produced an adequate change in the germ-plasm of this parent.

In view of the comparative insusceptibility of fully developed teeth to external influences changes in their forms during the life time of an individual can be but slight and of such nature as to preclude a corresponding change in the germ-plasm.

However, it is otherwise in regard to changes of the positions of teeth individually and more especially in regard to the form and position of the dental arches in their relation to the bodies of the jaws. The osseous base of the teeth is very susceptible to the influence of external agencies, undergoing constant and comparatively rapid alteration, and some of these changes are hereditarily transmissible.

I am inclined to conclude that the conceded prospective elimination of the third molar from the orthognathous types of man is to be explained by the compression of its late appearing germ.

In concluding permit me once more to use the words of Tomes:—"He would indeed be a rash man who ventured to assert that he had recognized all the agencies which are at work in the modelling of animal and vegetable forms; but it is safe to say that, at the present time, we are acquainted with 'natural selection,' or 'survival of the fittest,' an agency by which variations beneficial to their possessors will be preserved and intensified by successive generations; of 'sexual selection,' which operates principally by enabling those possessed of certain characters to propagate their race, while others less favored do not get the opportunity of so doing; and of 'concomitant variation' between different parts of the body, an agency much more recondite in its operations, but by which agencies affecting one part may secondarily bring about alteration in some other part."

Let us hope that the clinical observations of the orthodontist of the "New School" will assist in elucidating some of these questions.

Discussion.

Dr. F. B. Noyes, Chicago, Ill.

This paper is valuable in that it presents certain suggestive thoughts which can be taken to the laboratory and to the chair and verified by observation. A theory of hypothesis is valuable to any science in proportion as it suggests possibilities of verification. One which cannot be verified is of very little value, as it leaves us no farther along than we were before.

As you know, the question of hereditary influence as an etiological factor in malocclusion has been written upon very widely for a great many years. There are people who are willing to ascribe the whole etiology of malocclusion to degeneracy, and degeneracy is an expression of heredity. The expression is not the fault of the individual, nor of his environment or function, but the fault of the material that was given to him by his antecedents, in the makeup of his body.

If we ascribe everything to degeneracy we eliminate all possibility of any influence of the teeth on the jaws, or the jaws on the teeth in development, or any modification of development by normal or abnormal function. Therefore we must admit that it is not the only factor. Now I do not minimize degeneracy as an etiological factor, but I want to consider the possibilities of hereditary influences in the light of scientific knowledge at the present time, and as it has been presented in the paper, and in my judgment this has been remarkably well worked out.

I want to take up the first statement in the paper: "Orthodontia more than any other department of science attracts our attention to the relationship existing between the teeth and their osseous bases."

Evolution.

In the study of comparative anatomy one cannot help but be impressed with the fact that the teeth are developed, first, and the alveolar process is developed afterwards; that the tooth was, in its origin, a dermal appendage, and that these little hardnesses of the skin which happened to cover that portion of the animal which was used in obtaining food became developed to assist in obtaining and masticating the food. We find in the dermal scale exactly the type of tooth; the same tissues, a cone of dentin covered with a cap of enamel, bearing the same type of tissue and showing the same structure as these tissues present in the fully developed tooth. The connective tissue forms a ring of cementum around the base of the denticle which attaches the fibres of the connective tissue to it exactly as the cementum of the human tooth attaches the fibres of the peridental membrane to the tooth. In some cases, for instance the sturgeon, we find these individual spines becoming united by these bases, by continuous calcification, uniting one spine with another,

and so forming the armor plates of the sturgeon and the gar-fish. There is in the dermal scale no relation to the bone whatever. The hard spicule is held in the corium in the dermal layer of the skin by a form of calcified connective tissue which attaches the connective tissue fibres to the denticle.

But you can readily see that when those spines came to be used for mastication and prehension of food this was not sufficient, and the scales were pulled off and removed, and had to be replaced, as the scales through the process of natural selection became larger and larger in the origin of the jaw, the support which they required became greater and greater, until we had the formation of an additional support. This development has gone on in two lines, one adapted to one class of animals and another adapted to another class of animals. In one line of evolution the teeth become attached to the bone by the growth of the bone up to them, and the attachment of fibres of the connective tissue building them into the cementum of the tooth on one end and the surface of the bone on the other. That still being insufficient, the bone began to grow up around the tooth, and the portion of tooth to which the fibres were attached became longer and longer, forming the root, the bone growing up around it, so that we get a mutual relationship between the tooth, the connective tissue fibres and the bone, leading gradually to the development of a special portion of bone added to the original jaw, forming the alveolar process, which was put there for the purpose of fastening the tooth in its position.

In the other type of evolution, such as we have in fishes, instead of having that kind of relationship existing, we have in the conical pulp chamber, the formation of spicules of bone, and these spicules of bone gradually interdigiting and interlocking with spicules and dentin until you have the type of ankylosed teeth characteristic of fishes, which are absolutely immovable, and are attached to the bone, not by a direct continuity, I take it, but by an interlocking of bone formed in the pulp and dentin formed in the pulp, the pulp being tissue related to the tissue forming bone, and you have the interlocking of those calcified products attaching the tooth in that way.

So we see there are two courses which evolution followed in the relation of the teeth to the jaws. One the interlocking of bone and dentin through the activity of the pulp; the other the attachment of the outside surface of the tooth to the supporting bone, by a fibrous membrane. We are practically interested only in the form which developed the fibrous attachment of the tooth to the bone, and from the study of the way in which that has occurred, and from the study of the development and eruption of the teeth in man we can not but be impressed with the fact, that the bone of the alveolar process deserves the name which has been used for it occasionally, in connection with the lower animals—the bone of attachment.

Heredity.

If even one tooth is lost out of the arch, you have the loss of that portion of the bone which was developed for its support. Now having established the relationship between the teeth and bone, and granting that in the process of evolution the bone has been developed with the teeth, for the sake of their support, to what extent is it possible that one reacts upon the other in a hereditary way?

In order to get a conception of the action of heredity one needs to analyze a little between theories and facts. Heredity is a difficult question to discuss at the present time, and an especially difficult subject to study from the standpoint of life, because the facts and theories become so mixed. About twenty-five years ago there was some very remarkable work done upon the structure of living things, some very remarkable discoveries made in the structure of the cell, and the mechanism, if I may so call it, of life. From those discoveries a very wide range of deductions was opened, and a number of active minds, intense mentalities, took up these facts as suggested explanations of a great many different things which never had an explanation before. From those facts which were comparatively few they have elaborated immensely complicated theories of heredity and transmission, and I want to say again that those theories are of use to biological science just in proportion as they are capable of being demonstrated in the biological laboratory. As far as they can not be tested in the biological laboratory they do not advance our real knowledge. Let us go back for a minute, to these discoveries which started off the whole line of wonderful theories. What were they? Of course, the cell theory had been established. The structure of plants and animals had been worked out on a basis of cells. It was known that the animal body and the plant body were made up of individual units of life, and their products. It was known that each one of these units contained protoplasm and a nucleus, and that they were all derived from a pre-existing similar unit, by its division.

Influence of the Nucleus.

Now, a student in the laboratory working upon a single celled animal puts that animal in a bottle with pieces of broken glass, and shakes it up, chopping its body all to pieces, so that the single cell is cut into a number of pieces. He watches the pieces, and finds that the pieces of that cell which contain the nucleus or a portion of it continue to live, and to move, and begin to build up new protoplasm, and gradually reproduce a perfect cell; and that this perfect cell then divides and produces another perfect cell, while the pieces of the cell which contain none of the nucleus continue to move around in the water, and to manifest the phenomena of life for a longer or shorter time, but finally die. That is not

a theory. That is an observed fact. As a result of that work under the miscroscope, the statement can be made then that the nucleus exerts in some way (we do not know how), a controlling and directing influence over the protoplasm; that with the nucleus present the protoplasm will continue its building-up changes. Without this nucleus the protoplasm can produce only the tearing-down changes. You have there a relationship established between protoplasm and nucleus.

Then in observing the cell division it was found that the nucleus contained two parts, and one of those parts split up into a certain number of pieces, and that those parts equally divided, and were not only equally divided, but were systematically distributed in the diversion of nucleus, certain parts going to each cell. Then it was found that in the sexual reproduction the nuclear material was equally divided from the two parents, and in the first division of the ovum the characteristic amount and number of chromosomes reappeared. It becomes apparent from these observed facts that that chromatin, which appears in the first division of the nucleus of the fertilized ovum, is to be systematically distributed in every cell division which leads to the development of the new individual, and that that chromatin which is sent off into the various cells of the body is to control the activity of the cells. It is to control the development of those cells, so that at the proper time we have the enamel organ coming from the epithelium cells of the mucous membrane of the mouth, and we have the dental papillae coming from the mesoblastic cells of the jaw arch. The chromatin which is to supervise the formation of enamel has been sent into the enamel organ, and the mechanism is so perfect that when one begins to form enamel cells the other begins to form dentin cells and the two work together.

Heredity.

Now, what is possible? Is it possible that the chromatin which is to form one portion of the body should be derived from one parent and that which is to form another, from the other parent? We do not know that and until we do it is a waste of gray matter to spend very much time talking about it. To what extent is that development dependent upon other conditions? To what extent may development be inhibited or may it be increased by conditions of environment of the individual? That it is affected by the conditions of the environment of the individual is certain, for the one characteristic of life, is as Brooks has said, "adaptation, the ability to adapt itself to environment, and the changes of environment." Given a change of environment, in order to have a change appear in the individual which is being developed that would be transmitted to its offspring, it must produce not only a change in the tissue which is simply a reaction upon the cell tissue, adapting them to the environment, but that reaction upon

the cells of the tissue must have its effect upon the reproduction cells, the germ cells of the individual. In other words, the tissue must produce an adequate change in the germ plasm, as the essayist expresses it. How this can be done we do not know at the present time.

Inter-relation of Cells.

That leads us exactly to the problem which is at the present time most actively attracting the interest of biologists. Namely, "What is the relation between one cell and another of the body?" What is the possibility of one tissue or one organ affecting the other? The cells of the body are not absolutely independent of each other. The body is a unit and the individual cells of the tissues possessing a certain degree of individuality, a capacity for individual growth and activity, are related to each other to form a whole. They are parts of the whole. It is impossible to consider a body strictly as a colony of absolutely independent, individual cells, but as to any mechanism existing there, through which one cell influences another, we are at the present time in the dark, though there have been some very suggestive discoveries in the last five years. However, I think that as many problems have been in the dark for a long time, and then had a flash of lightning to illumine them, we may get a flash that will give some explanation of that interrelationship some time in the future. But we must remember that in order to have a condition which has been produced in this individual transmitted to its offspring, there must be a change in the chromatin in the germ cell which is to govern the development of the individual.

Alteration of Types and Number of Teeth.

If we have then established, following the line of the essayist, that there is the transmission of a germ or type of tooth, and that that type is capable of being influenced by its conditions, by its environments, and if we are aware, as we are obliged to know that in the reduced vigor with which the jaws are used we would expect a reduction in their size, the suggestion of the essayist in regard to the points at which this reduction in size affects the tooth, and the explanation for the points of attack is worthy of comment in my judgment. The third molar has been growing smaller, and is possibly being eliminated in the course of evolution. Why? Because its tooth germ is developed so late in the development of the individual that the bone which surrounds it is becoming harder and denser and has not been growing larger because of the absence of outside influences which would tend to make it grow larger. And that lack of room for the development of the tooth germ has its expression in the gradual reduction in the size of the third molar. In man, then, the third molar is the smallest, while in many of the other animals the third molar is the largest tooth.

Where is there any point at which the conditions and environment would have an opportunity of affecting the lateral incisors in their period of susceptibility, that is, in its period of formation? The essayist suggests the possibility of the union of the inter-maxillary and the maxillary bones, that union occurring early, or because of crowding and because of lack of environment, which causes a growth of the inter-maxillary bone, the lateral happens to alight at a point where it can be compressed by a failure of the normal development, and the tooth germ has been the natural one to show the effect of environment upon the development of the developing germ.

The work of Dr. Walkhoff, which was very nicely presented in the essay, is an exceedingly interesting one in this connection. It is interesting because it suggests something which in my judgment is capable of laboratory tests. In his pictures he shows that the skeleton, the frame work, the bony spicules of the jaw, are arranged in reference to the forces which come up from the surfaces of the bone which they support. Supporting the outside of the jaw we have the spicules running through the connective tissue, forming the cancelous bone which supports the outside shell, or layer of subperiosteal bone. In his X-ray pictures he shows that those plates come in lines which are related to the stress which is put upon the surface of the bone. Notice that this must be the result of, or an expression of stress put upon the cells of the tissues, causing them to arrange themselves in certain ways, and to build the bone plates in re-action and adaptation to the forces put upon them. Again an adaptation of life environment. Now, if that be true, and it seems to me very nicely shown, the result of stress which occurs upon the surface of the bone has its record in the depth of the tissues, not merely upon the surface of the bone directly affected. Is it not a suggestive thought that if we put an unusual mechanical stress upon the surface of the bone, or upon the tooth and the walls of its alveolus, we will set up a condition of internal stress in the bone which will produce a reaction on the part of the cells of the tissue, and we will have a modification of those spicules, the absorption and rebuilding of bone plates, readjusted to the stress? The suggestion to me then would be that the primary change resulting from force brought upon the teeth, and expressed in their alveoli, would be manifested, not so much in the wall of the alveolus, as in the spongy material surrounding the alveolus, and in a sense the alveolus would be moved through the spongy material.

Then there is another very important factor. After the movement has been completed is it not logical to suppose that if those teeth are held under a condition of stress not natural, and not capable of being brought upon those teeth in their normal and average functions, and the bone is

rebuilt in the condition, when the forces which produced that condition of stress are removed, and not having the teeth and tissues adjusted to the natural forces, that there will again be movement adjusting them to natural forces or to the forces which are habitually brought upon them normal or abnormal. Is it not necessary that in these movements the retainer should simply keep the teeth in the condition in which they receive, in a normal way, the forces which will habitually be brought upon them afterwards and thus produce a condition of structure in the bone which will hold the teeth in position? Your retainer, as I said before, is a reconstructed jaw-bone. Your *permanent* retainer is built of bone spicules and not of brass wire.

Dr. R. Ottolengui, New York.

Dr. Noyes made a suggestion as to why the third molar is smaller in man, and subsequently he explained to us what we call compressed laterals. Here is a clinical fact that I have observed: If a tooth is missing from the arch, and we seek it with an X-ray we usually find it present. The X-ray tells us its position. The lateral incisor, however, is frequently absent, and it is the only tooth, so far as my experience teaches, and I have been looking for them since the X-ray was introduced, that is ever found absent from the jaw, and I would like Dr. Noyes to advance some theory in explanation of that.

Dr. Noyes.

I cannot do it. That is about all I can say. It is true that the superior lateral is more commonly entirely absent than any other, but I think it is not quite true that it is the only one that is ever entirely absent. I have a case that came to me about two years ago, of which I have models and X-rays. The man was twenty-two years old, his only permanent teeth in the upper arch were the two central incisors, and the first and second molars. He still had temporary laterals and temporary cuspids, and one temporary molar on each side. The X-ray absolutely failed to show any trace whatever of a lateral, cuspid, or bicuspid, and it was interesting in that case because the mother and grandmother were deficient in two or more teeth. Some of these things I think will have to be explained as freaks. A part of the developmental material had gone in exactly the same sense as we find it partly missing in the spina bifida. We may suppose that the material for the development of certain tooth germs got side-tracked, and never did develope. I do not see any other explanation.

In regard to the peg laterals there is another factor. We have the factor of germ plasm handed down in a continuous line of heredity, and then possibly we may have cropping out in a later stage of evolution the type of a very early stage, a true degeneracy, the recurrence in the individual of a portion of chromatin which should have been lost way back in our great-great-grand-parents, in an evolutionary sense.

Dr. Milton T. Watson, Detroit, Mich.

I want to express my deep appreciation to Dr. Summa and Dr. Noyes, and I want to substantiate the statement of Dr. Noyes that teeth other than the lateral incisors are at times absent. I have skiagraphs of a case where bicuspids are missing, and the history of the case is sufficiently accurate to satisfy any one, for the deciduous teeth are still in place. I have other cases where bicuspids are missing, and the history has satisfied me that no extractions have ever taken place.

Dr. William J. Brady, Iowa City, Iowa.

I wish to add my word of appreciation for the excellent paper that has been presented to us, and I am glad to see that there is a tendency to investigate in this direction. When this society was organized its founders felt that there were certain things we needed to discuss which the ordinary dentist did not reach, and possibly did not comprehend. Among the various responsibilities which came to us is settling the matter of the effect of heredity upon malocclusion, and I am particularly delighted to find the trend of thought in this direction. We may take some credit to ourselves that at last really scientific study has begun regarding this very important matter.

Etiology of Tooth Degeneracy.

The discussion has drifted into the question of the formation of a peg-shaped lateral. There is a general law through which nature operates in regard to this matter which is found not only in man but in every animal that possesses teeth. All the teeth are built up from extremely simple sources—by an aggregation of primitive cones—and when there is no longer use for those teeth Nature disposes of them in exactly the reverse order in which she built them up. There is first aberration of form, then a reduction in size, then reversion to the primitive type from which it was built, and finally entire suppression of the tooth.

The teeth that are suffering most from the effects of disuse in man are first, the upper third molars, next the upper laterals, then the upper second bicuspids, and last the lower third molars. The upper teeth have been affected much more than the lower; the third molar has passed almost entirely through the first stage—aberrance of form—has long been in the second stage and is well on in the stages of return to the primitive cone and final suppression. The lateral incisor is a close follower, and if the present method of life keeps up both these teeth will be suppressed in time. The peg-laterals occasionally found now are examples of the workings of this law. The upper second bicuspid has reached only the second stage as yet, and occasionally examples are found of the first stage. I have several models showing great aberration of form in this tooth.

The lower third molar is largely in the first stage as yet, and it is well

known how aberrant in form this tooth is, being liable to be found in almost any condition in regard to its crown, though the roots—which naturally degenerate first—have passed into the later stage. It will be noted there are three teeth in the upper jaw that are well on the road to suppression against one in the lower. This difference might be reasonably explained, it seems to me, in this way: The lower jaw is the movable one, and has the benefit of exercise, as it is continually moving—in most people. The lower jaw is the active agent in mastication, while the upper is the passive, and this difference accounts for the more rapid degeneration of the upper teeth and jaws.

I am glad to see a tendency to discuss these matters, as they must be settled before we can advance orthodontia as it should be in the teaching of the future students of the subject. The present ideas concerning heredity have seemed wrong to some of us for some time, which belief has been strengthened with all further study performed, till now we are sure in our own minds that the old teaching is not true. Others are not so sure, however, and any error that has long been accepted as the truth requires a mighty effort to overthrow. We must not only satisfy ourselves that heredity does not operate as has been taught, but we must show the facts; prove it in all ways, over and over, and still again, and finally drive error from the field it occupies by an overwhelming and long continued onset of the truth.

Dr. R. Ottolengui, New York.

I was too positive in the statement that no other teeth but laterals are missing. What I really meant was that no other teeth seemed to be habitually missing. The superior lateral incisors are frequently absent and even among my own acquaintances I know of several.

I will not dispute the case that Dr. Noyes refers to, but I wish to make a comment on the value of evidence, because there are sometimes very startling statements that are naturally open to suspicion. Dr. Watson said he felt certain in one case, that there had been no extraction because the temporary teeth were still in place, and the X-ray showed no evidence of teeth below. A picture has been handed me of such a case. There are two temporary molars, with no picture of bicuspids under them. There is a very distinct appearance of the absorption of the roots of the superincumbent teeth giving you the appearance of teeth, while there is no shadow of a tooth. I have seen teeth erupt uncalcified. In one instance it was simply a tooth germ. Now you may question my diagnosis and believe that it may have been some other soft tissue, and not a tooth germ, because I did not prove it by a microscopic examination.

Here is another instance: I once had brought to me an infant with a loose temporary central incisor that had just erupted, and in the effort

to find out what was the matter with it, I was feeling it with my fingers. The complete enamel shell came off, and the dentinal germ was entirely uncalcified. That, of course, is an exceedingly rare case.

I want to make a suggestion as to the prevalence of the absence of laterals. It is an argument that is interesting, but we have not proved it. May there not be some connection between the absence of these teeth and the inter-maxillary suture at that point? We have two inter-maxillary bones, and finally the complete bones are united. What do we see in cleft palates? We often find the entire absence of one of those bones, and it is a common thing to find a lateral incisor absent, but the central incisor persisting and coming out on the opposite side of the medium line, so that you have two central incisors on one side of the suture, with one lateral incisor absent. You very often find right in the cleft both the cuspid and central incisor but the lateral is nearly always absent.

Dr. Edward H. Angle, St. Louis, Mo.

Mr. President, if we had plenty of time I would like to talk in confirmation of some of the points that were made by the essayist on this subject of heredity which is of such vital importance to us as orthodontists, but there is not time. It is, however, my duty as well as my pleasure to express my high appreciation of this paper. I do not believe that this society has thus far listened to a paper that has been given more conscientious study and hard work, but it is in direct keeping with the character of all the work Dr. Summa has done for this society,—painstaking, untiring drudgery. Whatever he does in the line of society work—and I have been associated with him in the work of other societies—is always faithfully, honestly and ably performed. So it is with real pride I commend this paper on this interesting subject,—one of a class of subjects which we must study broadly and intelligently if we would ever make much progress as specialists.

Now just a word in regard to my friend Dr. Noyes, who has discussed this paper so ably. Inasmuch as he is in reality more of an orthodontist than a dentist, for the character of his work must naturally be and is more appreciated by orthodontists than by dentists, and in view of the fact that he has been so loyal to this society, giving to us freely from his storehouse of valuable knowledge, I wish to propose his name for membership in our society. He will be eligible under our rules, I think, because he is a teacher in the school of orthodontia.

Dr. N. S. Hoff, Ann Arbor, Mich.

In regard to the incident which Dr. Ottolengui has brought up, that missing teeth are not always revealed by the skiagraph, I think that we ought to be a little careful. In my experience I have found that the skiagraph does not always tell the whole truth. I recently had three skiagraphs made of an impacted third lower molar. The other adjacent

teeth were clearly outlined, but no indication of the molar wanted was present. I knew it was there because I could feel it, and I afterwards extracted it. I think, therefore, that we should be very careful, and not depend always on the skiagraph in regard to these matters.

The paper which Dr. Summa read was one of the best that I have listened to in a long time, and I know that it will be productive of good results. The fact was beautifully brought out showing muscular attachment and its influence upon the jaws themselves in developing the bone tissues to their proper and normal condition. It seems to me that here is where we shall find an explanation for the numerous deformities which might have been prevented. I realize also that we may have accidental positions which we cannot control. It is only because we have abnormal functions that we get these abnormal results, and it would seem that we should not lose sight of the fact that we have a duty to perform from the biological or developmental standpoint as well as from the mechanical and corrective standpoint.

There is another point, and that is the influence of mechanical efforts to correct malocclusions of the teeth upon the alveolar structure which supports the teeth, especially of the mechanical appliances used. The work which we do should leave the jaws as nearly normal as is practicable, especially where we undertake to correct the mal-positions of the teeth in the developing jaws. We should carefully design the construction of the appliance and carefully control the manner of using it, so that we may not exert at any time abnormal pressure which may tend to produce pathologic results rather than physiologic results.

Dr. W. O. Talbot, New Orleans, La.

I would like to relate a case bearing on hereditary influences that cause the non-eruption of teeth. I have in my practice a family in which there are seven children. I believe four are brunettes and three blondes. The brunettes resemble their father who did not have all of his teeth. In each of the brunettes most of the permanent teeth are missing. Each of them has the upper central incisors, and the first permanent molars. Some of them have the lower incisors, others only the lower first bicuspids. Each of the blondes has a well-developed set of teeth, which was also the case with the mother, who was a blonde. Just what influence heredity has had in these cases I have been unable to determine, but I was unable to find any acquired cause of any environment that would have affected the development of these teeth in the brunettes. One peculiarity about the family is that in the lower jaw, what we usually term the alveolar process, has developed between the permanent teeth, and after the temporary teeth are removed the ridge stands in good line. After the permanent and temporary teeth have been removed the ridge is well formed, and carries an artificial denture well.

Duplication of Models.

By Dr. Walter H. Ellis, Buffalo, N. Y.

The sculptor and professional plaster men have long been familiar with methods for the duplication in plaster, of statuary, busts, bas reliefs, etc. It is but recently, however, that our profession has felt the need of familiarity with the technique of any of these processes. More especially has the orthodontist, with his many valuable models, wished for a process by which to duplicate them and it is with his needs in view that this paper has been prepared.

Any method that we may adopt will probably be along the lines used by the sculptor in similar work, with certain modifications to meet the requirements peculiar to our needs.

In order to cast a duplicate there must first be constructed, over the original, some kind of a mould in which to run the duplicate. There are three kinds of moulds in which plaster casts can be made; waste moulds, piece moulds and elastic moulds.

Various Forms of Moulds.

Waste moulds are of no value for the duplication of the orthodontist's models, but it is by this means that we get the original, for the impression and subsequent cutting away is a form of waste mould.

"A piece mould is made up of a number of pieces so arranged that

they can be placed together to form the mould." These pieces are sometimes very numerous, the Venus de Milo requiring three hundred. If the original be of plaster, is is first varnished with shellac and oiled. This fact alone would condemn it for our use as we wish to keep the original as clean and fresh as possible. This form of mould is the one used in making plaster duplicates of antique statuary.

Elastic moulds are the best and most practical for the duplication of the orthodontist's models. "These moulds are made of elastic material which will spring back into its original shape after being pulled from the cast and are kept in shape by an outer shell or case. The greatest advantage of this form of mould is the accuracy, ease and rapidity with which duplicates can be made."

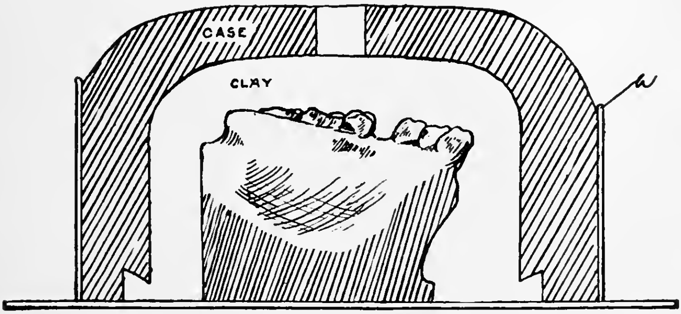


FIG. I

Elastic moulds are prepared by the use of gelatine and glue alone and in combination with wax, paraffine, glycerine, etc., but the best grade of gelatine will be found most satisfactory for our use.

Preparation of Shell.

The first step in the process is the preparation of the shell, or case which confines the gelatine while hardening around the model and serves later as the case to hold the gelatine mould in place while running the duplicate. Wrap the model that is to be duplicated with bibulous or tissue paper to protect it from the clay with which it will next be encased. Make this layer of soft moulder's clay about three-fourths of an inch in thickness, covering the top and sides but not the base. The thickness of the clay determines that of the gelatine mould. Place the model with its clay covering upon a glass slab. Put a small block of clay upon the top (Fig. 2-b) to form the opening in the case through which the gelatine will be poured. Wind a thin strip of clay (Fig. 2-a) around the sides close to the base, the upper surface of which should slant down as well as in, in order to form a slight undercut groove

in the base of the case, which will later serve the purpose of keeping the gelatine mould firmly in the case when the duplicate is being run. When this is done, build up a case of plaster over the clay. This can best be accomplished by first building up a wall of clay (Fig. 1-A) standing about an inch away from and around the model which will confine the plaster. When the plaster has hardened, remove the clay wall and take out the model. The case should be trimmed and shaped, and its inside given a good coat of shellac varnish, when it will appear as in Fig. 3-A. It is here shown with its gelatine mould. (Fig. 3-B.)

It is unnecessary to make a new shell for every model duplicated, for after having made a few, one can readily be selected to fit any model. These shells are fairly serviceable, but being of plaster, will, with frequent

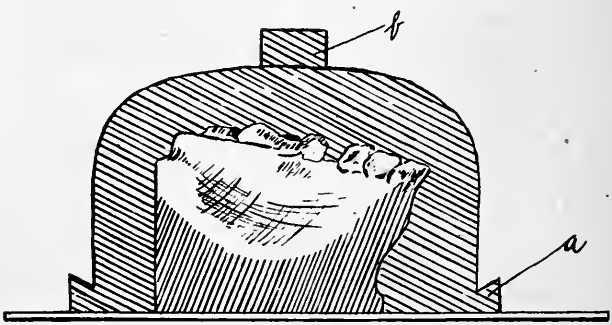


FIG. 2

use, wear and chip, especially around the base, allowing the liquid gelatine to escape while being poured. More serviceable shells can be made of tin or wood.

Figure 4-A shows a case made of wood. It follows the general lines of the plaster shell, is easily handled and works very well, but is rather light, needing weighting down when the gelatine is poured in. I have been using this case in preference to the one constructed of plaster.

Figure 4-B shows a case made in Germany which is constructed of tin. It is an ingenious affair and has its good points, but it does not hold the mould very securely, while the duplicate is being run.

Preparation of Models.

Having the case ready, the model should now be prepared. All that is necessary to keep the gelatine from adhering to the model is to give it a thorough brushing with powdered soapstone, applied by means of a soft camel's hair brush. However, if a more impervious coating is desired, one which will allow of a more ready separation of the model

from the gelatine, it can be given a very light coating of a stearine mixture prepared by melting two pwts. of stearine in one ounce of kerosene oil. This coating apparently evaporates in a few days, leaving the model practically as white and clean as before. But for those who wish to preserve the original in all its whiteness, a good thorough brushing with soapstone will be found to be quite sufficient. The model should now be lightly fastened to the glass by means of a small pellet of gum. Give the

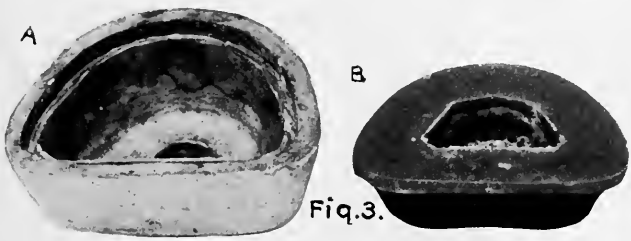


Fig.3.

inside of the case a good coating of the stearine mixture and set it over the model, which should be exactly in its center, leaving an even space all around for the gelatine. Figure 1 shows this very well; the clay, of course, having been removed.

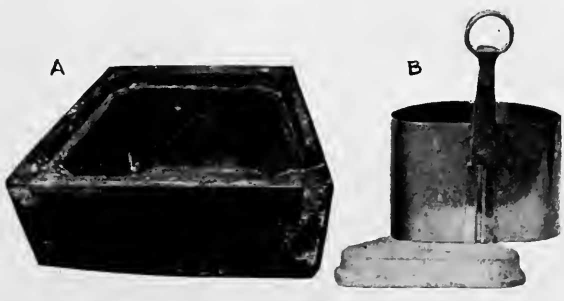


Fig.4.

Management of Gelatine.

It is now ready for the gelatine which must be prepared and handled with the utmost care. I have been using the best grade of French gelatine which is made for use in jellies, clarifying wines, etc. It comes in thin sheets put up in pound packages costing forty or fifty cents a pound. Procure an ordinary double boiler in which to melt the gelatine. The sheets should be first dipped in water, then placed in the boiler, with enough water to make it of the proper consistency when melted—one teacupful to one-half pound of gelatine will be about the right proportion.

It is very important to have it of just the right consistency, if too thick it will not be elastic enough. If too thin, it will be weak and flabby.

Heat slowly, only long enough to thoroughly melt it. In warm weather it is best when melted to add a few drops of carbolic acid, diluted in a little water, to prevent spoiling. Stir occasionally and remove from the fire as soon as melted. It should not be used hot, but allowed to cool to about 95 degrees F., when it will feel neither hot nor cold to the fingers, meanwhile stirring occasionally that it may cool evenly. Pour slowly into the case. If it shows signs of leaking out under the case, a little wad of clay will stop it. Allow it to stand some hours, preferably over night, when the gelatine mould can be removed from the case and

Fig. 5.

the model pulled from the mould. It should, of course, be worked very carefully in pulling it out, but this can be accomplished, without cutting or tearing the mould or fracturing the model. There may be exceptional cases, however, where slits at the heels of the mould will facilitate matters. Allow to stand half an hour or so after the model is removed so it will settle back into shape.

The surface of the gelatine would not need treating to preserve its shape under the action of the plaster. It should first be brushed with soapstone which fills in the pores and smoothes the surface. After the soapstone is removed, the surface should be brushed over with alum water to harden it. (Alum water is prepared by dissolving half an ounce of powdered alum in one cup of boiling water.) When this is dry, brush very lightly with the stearine mixture which will cause the duplicate to separate more readily from the gelatine. Olive oil or vaseline might be used instead, but are more likely to cause discoloration of the duplicate.

Use the best grade of plaster—one that sets readily, and mix very carefully, in summer using ice water, or the heat generated by setting

plaster will injure the mould. Paint in the plaster carefully with a brush, gently shaking, to work it to place. Replace the mould in the case, laying a piece of glass over its top to make a smooth base for the duplicate. Remove the model as soon as the plaster is set, to lessen injury from the heat. Brush in a little soapstone and give it a very light coat of stearine mixture just previous to the running of each duplicate. This will keep the surface of the gelatine smooth and allow of ready separation, and also protects it from injury due to the action of the plaster.

Six to eight good duplicates may be obtained from each gelatine mould, duplicates so good that they can hardly be distinguished from the original. Fig. 5 shows an original set of models and a duplicate set.

Gelatine moulds can be kept for a considerable length of time if placed in a cool, dry room and not exposed to the air, but it is best to run all duplicates needed when the mould is fresh, thus insuring greater accuracy.

When through with the gelatine mould, it should be cut into small pieces, spread out on paper in a cool, dry place to harden, thus keeping it from spoiling, as water in gelatine causes it to become mouldy. If it gets grainy or dirty, it should be skimmed and strained through cheesecloth. If well taken care of, the gelatine can be used repeatedly, requiring the addition from time to time of but little new material.

Discussion.

Dr. J. Lowe Young, New York. I am very much interested in this paper, and in the results shown this afternoon. The only criticism I have to offer in regard to this paper concerns the measurements, which I think are not scientific. It seems to me that a teacupful is a very indefinite quantity, and I think we should be very particular regarding such details.

This afternoon Dr. Ellis gave me an opportunity to examine many of his duplicates, and in some cases I could not see but that the eighth duplicate was as accurate and perfect as the first one. I could not distinguish anything in the first one different from the original. To my mind this is a very fine showing because I have experimented along this line, but have never been able to show any such results as he has obtained.

Dr. H. D. Keeler, Baltimore, Md. I find that by adding a little glycerine in making the gelatine I get a much better result. The gelatine is kept soft, whereas otherwise it gets hard, and will not work nearly so well. I use a very little water to dissolve the gelatine, depending a good deal on the glycerine.

Dr. Ellis. I do not know that there is anything I can add. There seems to be a lack of familiarity with this subject. I am very glad, indeed, to offer the results of my efforts to the society, and I hope all of you will get as good results as I have succeeded in obtaining. As Dr. Young remarked, shortly before I came here I made a gelatine mould, with eight duplicates, and as far as I could judge the eighth was as good as the first.

Normal Occlusion vs. Normal Dental Relation.

By Herbert A. Pullen, D.D.S., Buffalo, N. Y.

The stirring up of heretofore latent thought concerning the theory and practice of orthodontia by the individual and organized efforts of the members of this society in various parts of the country, has awakened a new interest in this science through the elaboration, by essay and discussion, of the principles of occlusion in its various relations to orthodontia, and although these have been enthusiastically received by the profession as a whole, we have anticipated and are prepared to meet, in a spirit of friendly antagonism, the criticisms and opposing theories of those practitioners and specialists who have been working along somewhat diverging lines in their practice and teachings relative to some of the fundamental principles of the doctrine which we have promulgated, hoping, by a more comprehensive elucidation of the same, to clear up some of the misconceptions which have arisen in regard to them.

In the following and later quotation from an article by Dr. Case in the July, 1905, Items of Interest, entitled "Principles of Occlusion and Dento-Facial Relations," an exception has been taken to certain published statements of the writer, on the basic principles of occlusion and their relation to facial harmony:

"Again, the particular phase of the theory which promises that normal occlusion is incompatible with irregularity and imperfection of contiguous facial outlines, has been extensively exploited by the "new school," but in no place has the writer seen it so completely, concisely, and poetically stated, as from the pen of Dr. H. A. Pullen, of Buffalo, N. Y."

The one poetical statement to which Dr. Case refers, is probably the paragraph which credits Dr. E. H. Angle with the discovery of the important relation which normal occlusion bears to orthodontia, and is the

"radiant star" discovery referred to in the writer's discussion of Dr. Case's paper before the Institute of Pedagogics at Buffalo in 1904, and not the treatment of upper protrusions by use of the Baker anchorage by Dr. Angle, to which later discovery Dr. Case has misapplied my unfortunate lapse into the language of the muse.

Evidently such a lapse into the poetical phraseology is a serious digression from the pathway of practical science, and I assure you that nothing but the personal enthusiasm created by Dr. Angle's discovery of normal occlusion could have called forth the simile and metaphor which Dr. Case is pleased to call poetry.

One statement of mine to which Dr. Case takes particular exception refers to the incompatibility of normal occlusion with any degree of malocclusion, as follows:

"We would have it understood that normal occlusion is incompatible with any degree of irregularity, and with this *ideal* relationship, normal occlusion and normal facial lines are inseparable."

In Dr. Case's subsequent criticism of "new school" theories, his chief arguments have been directed against the verity and soundness of the doctrine expressed in the above quotation; hence I shall take up this statement first, and point out the difficulty which I believe he encountered in understanding it.

You will note in my repetition of the quotation that I have specially emphasized the word *"ideal,"* as upon this word alone rests the solution of the misunderstood statement.

Occlusion.

In the same discussion of mine in which the above statement occurs, may also be found a definition of normal occlusion, which ought to throw a light upon what we mean by this condition, and I quote as follows:

"Normal occlusion is a condition of *perfect relationship* existing between the normally formed and aligned teeth of maxilla and mandible *when in antagonism,* the mandible being in its farthest posterior position, and in perfect median register with the maxilla, and both in normal relationship with contiguous tissues."

I quote also the paragraph following this definition: *"Such a condition precludes abnormal relationship of contiguous tissues,* such as over- or under-developed alveolar or maxillary zones, or maxillary or mandibular protusions or retrusions, and its *most perfect conception can only be seen in a perfect anatomical subject."*

With these points of preference, normal occlusion and normal dental relation are not synonymous by any means, the former referring to an ideal relationship as specified and limited in the definition, to the perfect anatomical subject, and the exact position of antero-posterior and

median register of the teeth in antagonism (the word "occlusion" giving us the basis for the latter statement, since it means the approximation or closing of the teeth together); while the latter term "normal dental relation" as used by Dr. Case, may refer to any position of the teeth in articulation, since it is unlimited to a position of occlusion, for the word relation is not absolute unless limited or restricted to the exact meaning which it is intended to convey.

Therefore, we cannot agree to the synonymical use of the terms "normal dental relation" in Dr. Case's definition of a standard anatomical articulation. Nor can we accept as synonymous terms, the words "articulation" and "occlusion" as I will show a little farther on in my paper.

We have gone one step farther and defined a position of normal dental relationship, and designated it in its limitations as normal occlusion.

It has been suggested that we use the word "occlusion" alone to designate this ideal relationship; that the word "normal" is unnecessary, because if occlusion is anything it is normal; otherwise, malocclusion is the proper word, but I am not prepared to accept this term without limitations in referring to the typically ideal anatomical occlusion.

Webster says: "A thing is normal, or in its normal state, when *strictly* conformed to those principles of its constitution which mark its species. It is abnormal when it departs from those principles."

In the past, the word "occlusion" has even been used synonymically with articulation. We speak of the "occlusion" of the teeth when we refer to the relation of the interdigitating cusps, whether there is a normal occlusion or malocclusion present, but when we desire to be exact, the specific meaning of the word "normal" in connection therewith leaves no room for doubt as to the interpretation which is intended.

In all branches of art such as sculpture, painting, architecture, etc., a model of perfect art is chosen as a guide to reproductions which represent the highest conceptions of a certain type, whether it be the Apollo in sculpture, the Madonna in painting, or the Renaissance in architecture.

Normal occlusion is the highest conception of a type, not a relative nor approximate condition. It is an ideal state of physical integrity, and, as stated before, can only be perfectly conceived in a perfect anatomical subject, which would necessitate, therefore, the normal, typical and perfect development and relationship of contiguous tissues of the hard and soft anatomy of the bones of the head and face, and the artistic conformation of the overlying tissues which make up the facial lines of beauty and harmony of profile.

Nor do we claim that normal occlusion in the ideal is commonly found in any type, indeed, it is quite the reverse, though we find many

approaching the ideal to such an extent that they vary but little from perfection.

Again, we do not claim that it is always possible to restore the ideal in any case of malocclusion, but its approximation is best assured by following out the teachings of occlusion in the treatment of these cases.

How near we approach the ideal in results both as to restoration of normal occlusion and harmonious facial lines, we leave you to judge from the published cases which have been treated from the standpoint of occlusion by those who have been working along these lines for some years, and even by those who have only begun the study of occlusion and perhaps have completed but one case restoring the dental arch to the normal in occlusion with gratifying results.

It must be admitted that the term "restoration of normal occlusion" may be only a relative one when used in reference to any case in which the absolute ideal is not established as the result of our efforts, but that does not detract from the fact that normal occlusion is the ideal which gave us the insight into the proper treatment of malocclusion, and the inspiration to work out the intricate problems presenting, no matter what degree of skill we may possess nor how humble our efforts may appear.

With this interpretation of normal occlusion, the statement of the incompatability of normal occlusion with any degree of irregularity and the inseparableness of normal occlusion and normal facial lines which are the subject of Dr. Case's criticism, cannot be disputed.

Also, with this understanding of normal occlusion, another statement from the same source that "the teeth in normal occlusion may also be quite irregular" must necessarily have been made from a misconception of the requirements of normal occlusion.

Let us mention for further proof the following characteristics of normal occlusion:

1. The normal shape and size (according to type) of each arch.
2. The normal position of each tooth in each arch.
3. The normal shape and size of each tooth (varying with type) in each arch.
4. The normal relationship of each arch to the other, and of the occlusal inclined planes of the cusps of the teeth to those of the other.

This last characteristic must be limited to the most constant relationship between the arches of teeth, to the position of the mandible at rest, the teeth being occluded as when the mouth is closed.

And here is where we must make the distinction between occlusion and articulation, for they are not synonymous terms, though each has its own peculiar relationship to orthodontia and to each other.

Articulation.

"Articulation is the relation between the teeth of maxilla and mandible during the lateral and protrusive excursions of the latter, dependent on its universal articulation at the glenoid fossa."

There are three distinct stages of articulation, viz., prehension, attrition, and occlusion. The first two represent the mandible in motion, the last the mandible at rest, the teeth being closed.

Occlusion is a passive phase of articulation, while the other two stages are active.

Occlusion represents the static, and articulation the dynamic relation between the teeth of maxilla and mandible.

The very fact that occlusion represents a static relationship between the arches of teeth makes it obvious that it should be designated as the basis from which to diagnose malocclusion.

Diagnostic Value of Occlusion.

And now we come to a consideration of normal occlusion as a primary factor in the diagnosis of malocclusion, which our critic also takes exception to in his denouncement of the following statements of the essayists as false teachings:

"The facial lines are dependent upon the normal occlusion for their normal relationship, hence the occlusion is the factor of *prime* importance rather than the facial lines."

"Shall we diagnose a case of irregularity from symptoms which disappear upon treatment of the occlusal relations of the teeth?"

I have given special emphasis to the word "prime" in the first paragraph above, as upon its modification of the sentence depends the soundness and scientific value of the statement.

In other branches of orthopedic surgery the morphological anatomy of the overlying soft tissues is not considered as essential and primary a diagnostic feature as the deformed structure of the underlying osseous structures, e. g., curvature of the spine and club-foot are diagnosed from a primary discernment of the abnormality of the bony tissues underneath. A restoration of the symmetry of the overlying tissues can only be accomplished by a restoration of the normal form and position of the osseous structure which is so deformed.

For the same reason, therefore, the facial lines are dependent upon the osseous structures of the face, the formation and relative positions of maxilla and mandible, and the teeth and their processes, for their harmony or inharmony of form, and a reversal of this natural order of etiological characteristics would be an absurdity.

Consequently, faulty facial lines should be regarded as symptoms

rather than causes of an existing deformity of the osseous structures underneath.

So it is we have come to look upon the relation of the arches of teeth in occlusion, taking into account, also, the relationship of contiguous tissues, the variation of the normal relationship of the maxillary bones to the other bones of the head, as primary diagnostic considerations rather than the facial lines.

Bimaxillary protrusions or retrusions can be as readily noticed and more exactly diagnosed from an examination of the abnormal relations of the osseous and dental structures as from the superficial examination of the relatively normal or abnormal positions of the lips or soft tissues of the chin, etc.

But aside from the consideration of the primary importance of the occlusal relations in preference to the facial lines in diagnosis, it is the treatment also which furnishes us with a claim for primary consideration, for invariably the underlying osseous structures are primarily treated and restored to normal anatomical relationships as far as possible in any case, and not the facial lines, which conform themselves to esthetic outlines and symmetrical contour only in so far as the underlying structures have been restored to normal relationship and function.

It is true that the consideration of malocclusion and inharmony of facial lines can hardly be separated in diagnosis and treatment, so closely are they associated, but it is also true that "the facial lines are dependent upon the normal occlusion or malocclusion," and they are not interdependent to the extent that the reverse of the statement would have any claim to a serious consideration.

In support of my claim that the teachings and deductions made from the basis of occlusion are not "an erroneous theory of dento-facial harmony," as Dr. Case attempts to show, I wish to quote the following paragraphs from chapter XVII, of Dr. Angle's work on malocclusion of the teeth, relating to general treatment:

"In the treatment of all cases of malocclusion our efforts should be toward the accomplishment of three main objects:

"First, correction of malocclusion.

"Second, establishment of harmony in the relations of the jaws.

"Third, improvement of the facial lines.

"In the accomplishment of these our efforts should be toward the ideal, where normal occlusion, normal relations of the jaws, and harmony of the facial lines are combined. While the ideal is not always possible to gain, yet the best attainable results cannot be hoped for with a lesser standard."

Treatment along these lines cannot fail to produce "dento-facial harmony," if this means as I interpret it, the restoration of the most esthetic and harmonious lines to the profile, including the establishment of the most ideal conditions of occlusion possible in a given case.

Twelve years ago the theory of occlusion was not recognized as a very essential feature of operations in orthodontia, in fact, occlusion was seldom mentioned as a factor of any importance.

Instead, the regime of the regulating appliance as the factor which gave the trend to progress in this science was at its height if we can correctly judge of general conditions from a quotation from one of the '93 papers of Dr. Case, read at the Columbia Dental Congress. He says: "The practice of correcting irregularities of the teeth has advanced so rapidly under the influence of modern methods of constructing regulating appliances that it to-day bears little relation to dentistry proper, and in its most advanced practice may justly claim a distinct field in science and art."

Because Dr. Case seems to have found a class of cases which were apparently not to be treated by any definite rule as outlined by Dr. Angle in his treatment of cases according to class indications, does it overthrow the whole finely worked out theory of occlusion as a basis of diagnosis and guide to treatment?

It is true that full bimaxillary protrusions and retrusions, and varying degrees of abnormal relationship of the maxilla and mandible do exist, but it is also true that they are very apparent exceptions to the general run of protrusions, and yet, when carefully analyzed, are found to be but modifications of Classes I, II, and III, of Dr. Angle's classification of malocclusion.

The Baker Anchorage.

The idea of absolute reciprocal movement of upper and lower teeth in treatment of protrusions and retrusions with which Dr. Case credits the "new school" is an absurd misconception of the "Baker anchorage" as we choose to call it, since, although Dr. Case may deserve priority of credit for the use of the rubber ligature in producing "intermaxillary force," the particular method of its later use in the "Baker anchorage," as applied by Dr. Angle, is quite dissimilar to that for which Dr. Case utilized it.

The use of the rubber ligature has been applied by the "new school" as a reciprocating force only in so far as the physical and mechanical characteristics present will allow, and the requirements of the case in which it is applied will demand.

The following are many of the uses to which the "Baker anchorage" is adapted in treatment of malocclusion:

The use of either arch in phalanx as anchorage for the attachment of the rubber ligature to resist a movement of one or two or more teeth in the opposite arch, for which a greater resistance is needed than reciprocal anchorage.

The upper arch used in phalanx as resistance for the consecutive movement of the lower anterior and buccal teeth when the ligature is applied especially for this movement.

The lower arch used in phalanx as resistance for the consecutive movement of the upper molars, bicuspids, cuspids and incisors, when the rubber ligature is applied especially for this movement.

Its use as an auxiliary to any mesial or distal movement of one or more teeth.

An equally reciprocal movement is not claimed in any of these cases, though it may be and is accomplished in some cases by proper manipulation of appliances so as to restrict the action of the rubber ligatures in one arch or the other as the case demands. An exactly equal reciprocating movement of the upper and lower teeth is not obtained by an unrestricted action of the rubber ligature in any case. As pointed out by Dr. Ottolengui in his editorial on this same article of Dr. Case's, "in order to achieve exactly equal reciprocal movement between two objects bound together by an elastic, it is absolutely requisite that the two objects shall be equally stationary, and therefore equally easily moved.

"There probably never was a case of exactly equal reciprocal movement between two jaws produced by simple intermaxillary force, unrestrained, and, therefore, it would be folly to advocate such an undertaking. By a wild flight of the mind one may imagine two jaws moved with equal ease mesially, or with equal ease distally, but it is not conceivable that one of these jaws could be moved let us say a quarter of an inch distally with the same force that would be required to move it the same distance mesially.

(By jaws in this argument is meant the teeth and their processes.)

"It therefore follows theoretically, that in all mesio-distal reciprocal movement of two sets of teeth simultaneously, the set moved mesially travels a greater distance that the set moved distally, dating such measurement from that period in the work when all teeth are in approximal contact."

The use of the rubber ligature as a means of applying force requires a great deal of judgment and skill in many cases, and it is not to be credited that the "new school" men are entirely lacking in these qualities as Dr. Case would have us believe.

Our critic himself defines the use of the reciprocating force of the

rubber ligature in no uncertain terms in the following quotations from one of his papers read at the Columbian Dental Congress:

"The principal force, therefore, should be exerted upon the anterior superior teeth, and this force may be *reciprocated* by rubber bands extending from the posterior parts of the upper appliance to the anterior part of an appliance that is attached firmly to all the lower teeth."

"When the central features of the face are depressed with anterior superior teeth occlusing posteriorly to the lowers, accompanied with the real or apparent prognathous lower jaw, *great reciprocating force* may be beneficially obtained from the rubber bands before mentioned."

Since Dr. Case's use of the rubber ligature seems to have been limited to its action as an auxiliary to other force appliances, as noted in his published statements, the "new school" must be given credit for the conception of its uses as an efficient intermaxillary force, as modified and restricted in the "Baker anchorage."

From the diminutive size of the models as illustrated in Dr. Case's article, it is impossible to make any exact deductions as to the results of his treatment by extraction and patching up the occlusion in most of the cases, but we note that in no case has he restored the normal occlusal relations of the arches of teeth.

Must we conclude from his published cases that the restoration of normal occlusion in these mesio-distal malocclusions *et al.* is not a common procedure with him?

Indeed, a case of normal occlusal restoration would be hard to find among the published cases of any class which our critic has heretofore presented, and yet he states that "the true anatomical and physiological principles of normal occlusion *per se.,* in its relation to orthodontia can hardly be called a 'discovery' of recent years," and that "the teeth in normal occlusion may also be quite irregular."

Theoretically, Dr. Case assumes that we are pursuing false treatment, by restoring normal occlusal relations in cases of malocclusion, but practically our results show more perfect restoration of harmonious facial lines than it is possible to produce by any other method of treatment of the occlusal relations.

Are we to accept such positive statements based upon the inaccurate plaster models presented as evidence and final proof?

Are we to go back to the old regime of extraction in cases of mesio-distal malocclusions of a greater or lesser degree of severity?

Must we, in order to "possess the slightest conception of the higher planes of perfection which marks the sure trend of this department of dentistry," accept a lesser standard than the ideal, with a temptation to

resort to methods which require less skill in the accomplishment of only mediocre results?

Is the fair-minded student to accept conclusions based upon deductions made from a selection of a few mesio-distal malocclusions which apparently do not conform to the general rules laid down by the "new school" for the treatment of this class of cases?

A negative answer to these questions will surely be accorded by the members of the "new school" and all others who are appreciative of scientific progress along the lines of theory and practice which appeal to sound judgment as being reliable because based upon accurate methods of prognosis, diagnosis and treatment of malocclusion.

Discussion.

Dr. E. P. Bethel, Columbus, Ohio.

It seems but natural to suppose that in restoring the parts, by bringing the teeth into occlusion, the surrounding tissues would be left in the most normal condition, that is, the nearest to that intended by nature.

Nature may make mistakes in molding features, but are they as frequent and great as those made in attempting to improve on nature by extraction of teeth and bringing parts into relations different from those nature has provided? It is a question how much the orthodontist may with impunity deviate from this apparent facial harmony established by nature for the various types of faces that we present.

We cannot expect, as Dr. Pullen says, to always get ideal results, that is, ideal from our standpoint of observation; but we can get as near to the ideal as possible by putting the teeth into occlusion and establishing the corresponding relations with the tissues influenced thereby.

In the so-called "bimaxillary protrusion" cases, how far is it safe to go beyond the establishment of normal occlusion, by means of extraction? Is it justifiable to carry back still farther the teeth, oftentimes perhaps the roots as well as the crowns, to establish a permanent betterment of the facial contour?

Is it positively known that carrying back the teeth bodily in the upper jaw will not, with the re-establishment of osseous structures, in some way encroach upon the nasal cavity and eventually bring about some unlooked for pathological condition—that is, if the roots remained in new position?

If there is a tendency of the apices of the roots so moved to return to their original position, then, with elongation of the crowns resulting

from two extensive tooth-movement and their lingual inclination through return of the apices of the roots to their original position, would it result in an improvement of the facial contour over that established by simply bringing the teeth into occlusion? I believe the members of the so-styled "New School of Orthodontia" are all speaking for the truth, whether it be in scientific investigation or through discussion, and are willing to accept the truth when established. I am sure we all feel that we want to progress, but in that progress make our steps sure, so far as possible.

Dr. Pullen. I am sorry there has not been more discussion on some of the points brought out in this answer to Dr. Case.

It was necessary at the Pedagogical Society meeting last January to define "normal occlusion" in an absolutely specific manner, in order to be exactly understood when speaking of it in the definite relationship which it bears to the surrounding anatomy of the head and face.

If it cannot be shown that normal occlusion is a definite basis for deductions in orthodontia, then must diagnosis be inaccurate and unavailing, and treatment correspondingly indefinite in method and result.

My paper was intended as an argument along these lines, and I appreciate very much the kind reception you have given it, although it did not evoke as general a discussion as I had hoped.

Art in Model Making.

By Dr. Alfred P. Rogers, Fall River, Mass.

I believe my first duty this afternoon is to ask your indulgence, because under the title of my paper I feel that I must present many details with which you are already familiar. I am prompted thus by the fact that I wish to give my paper as wide a range of usefulness as possible. The profession of dentistry is in need of many of these details. Therefore, my wish is to show, not only how model making lies at the very root of all our efforts in orthodontia, but to emphasize the fact that the general practitioner should be conversant with these methods, if for no other reason than that he sometimes meets with cases of universal interest, which should be preserved for the profession, and unless he is proficient in model making, his efforts stand only as a sad commentary on one of the deficiencies of the dental profession.

We believe in harmony and balance. They are very essential points with all of us. We have not despised art in our work, for we have recognized that harmony and beauty are synonymous. It is this recognition that causes me to say most earnestly that we should tolerate nothing in our work that is disproportionate or ugly.

Those of you who have given the least attention to the literature of dentistry, or who have observed, ever so slightly, the methods in vogue, must have been impressed with the almost utter lack of art in relation to model making. Indeed, one idea prevalent with the dental profession

is that the model has little value as a record; that it may be carelessly made with little or no thought of perfection or minuteness of detail. Dentists seldom seek, and almost never receive, as far as I can make out, right training along these lines. It is our regret that our museums are filled with an array of unattractive and ugly models intended to be preserved as records of some of the most unique and interesting specimens, when they should be filled with models of artistic beauty and worth.

I wish to add that it is undoubtedly true that we must learn to see before we can understand the mouth conditions to fully appreciate them. One never fully sees a landscape until he has learned to draw one, nor does he truly know the flowers until he has learned to represent them. May we expect, then, that a man may see and understand the mouth with its defects and requirements before he has learned to accurately represent it? We cannot expect to do our highest work without the highest and best facilities for study and discernment. Yet some would have us use faulty and uncertain methods in this work, and the worst of it all is that such methods have long brought discredit upon work which might have turned out to be of permanent value. But we must not condemn, but rather admonish, those who so practice and advise. Let us hope that in the future there will be seen fewer of these grotesque and distorted models held up for the world to see. Would that they could but recognize that that upon which our labor has been spent, and is often so apparent in the product, has one of the deepest claims for their admiration; that the making of a beautiful model has a distinct value in itself, which claims for it recognition and encouragement.

Value of Perfect Models.

The model which I have in mind, and about which I wish to speak to you this afternoon, must be an unchangeable record of fact. Anatomically, it must be a perfect representation of mouth conditions; all of the teeth with their delicately curved surfaces, their incline planes, grooves, and root inclinations; the gum tissues with their stipples, the delicate muscles, and muscular attachments, all must be present. In proportion as these are absent, the model becomes worthless as a scientific record or work of art. The correct model must not only have these essential points, but its artistic proportions must be tastefully executed and harmonious throughout. Every angle in its proper place, capital and base in exact proportion to its anatomical column. Its surfaces as smooth and clean as polished marble.

One of the greatest and most comprehensive steps in the diagnosis of malocclusion is Dr. Angle's classification. Now the best aid to correct diagnosis is a perfectly made model.

My main purpose, then, is to determine with your help what art in model making practically includes, and how we are to obtain the most accurate and artistic results. I shall make no effort to reach its compass, but shall be satisfied to bring before you a few thoughts, leaving much for your discussion.

The Impression.

The first and most important step in our work is the impression. Accuracy is the keynote here, as in all other operations in orthodontia. Without accurate, painstaking methods a perfect impression is impossible; with them the work becomes a pleasure. Fig. 1 illustrates an accurate impression of the lower arch.

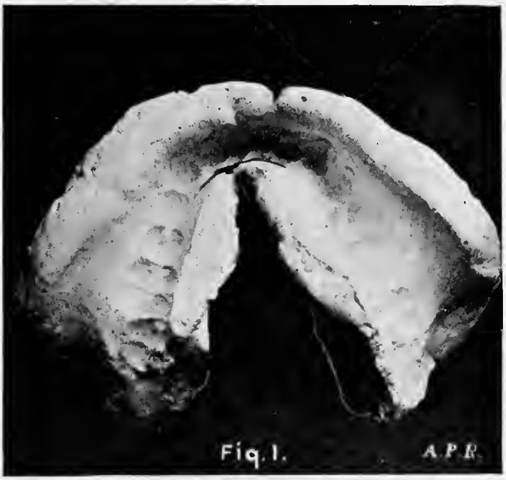


Fig. I.

Fig. 2 illustrates an accurate impression of the upper arch. Notice here the full deep impression of the buccal and labial spaces. This is one of the great essentials to an accurate impression for model making. Our first care in securing a good impression is in regard to the patient's mouth. All deposits and foreign particles must be removed, and the teeth thoroughly cleansed. A suitable tray is then selected, and bent to fit the mouth accurately, leaving sufficient space in every direction for a good thickness of plaster. With the patient's mouth in readiness, and the tray in a convenient position for filling, we proceed to mix the plaster, using distilled water about 70°. The plaster which you have found by experience best suited for the work, is then slowly sifted into the water with little or no stirring. When the last particle has disappeared below the surface of the water, the surplus is poured off and the plaster is ready for the impression. The grooves of the tray are then filled. Should the impression

be an upper one, the roof of the tray receives no plaster at all. Placing the tray where it may be readily reached, we proceed to fill the buccal and labial spaces, using a bone spatula to insure ease of application and cleanliness. When the plaster has been carefully worked under the cheeks and lips, and all the air expelled, we place the tray firmly in position. Sufficient time is then given for the plaster to harden before the tray is removed. At this stage many fail, being tempted to remove the impression too soon.

Every particle of softened and broken plaster is now removed with

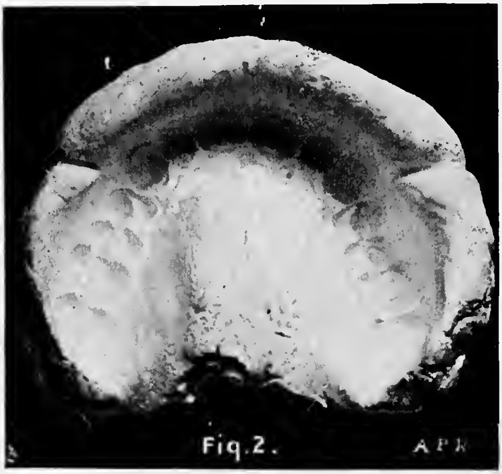


Fig. 2.

the aid of pliers and rolls of cotton. Grooves are then cut in the cuspid region, and the plaster carefully pried from its position, using care to apply the force in such direction that the impression of the inter-dental spaces will not be broken from the main portions. As the pieces are removed, they are set in order upon a clean blotter bearing the patient's name. When sufficiently dry the pieces are accurately placed in position, not, however, until the edges have been carefully dusted with a camel's-hair brush. The small pieces are first united to the larger by the aid of a celluloid cement, then the whole impression is assembled. In spite of the utmost care, we sometimes find it necessary to retouch the impression. A porous spot, an air bubble, or it may be the line of fracture is too apparent. These slight defects are better corrected in the impression, and, if nicely done, not only improve the model, but render subsequent carving unnecessary. It is fine work, and must be done with care and skill, much the same as a negative would be treated. In fact, the camel's-

hair pencil used by the photographer is admirably suited for this work. The pencil is thoroughly wet in clean water, and upon its point a small particle of plaster is carried to the marred surface, with which it is carefully painted; the water sinking into the dry surface of the impression carries the plaster with it. When this work is done as it should be the surface of the impression is not changed in the slightest, but the defects are nicely obliterated. It must not be supposed that this method may be used for building up impressions or supplying lost pieces; its mission is abused when it is so used.

Fig. 3. A.F.R.

Varnishing. Much care is needed in the next step of varnishing the impression, that the fine lines may not be destroyed by using too thick a varnish or by applying too many coats. It is better to have the varnish quite thin and apply an extra coat if needed. It is difficult to make clear just how heavy the shellac and sandarac varnish should be.

Pouring the Impression. When the shellac and sandarac varnish have sufficiently hardened we prepare for the model, by first thoroughly soaking the impression in water. This is done to insure an easy separation of the impression from the model, as it prevents the infiltration of water, carrying with it minute particles of plaster. It has been my observation that we procure better results when the plaster is allowed to settle in the water with little or no stirring, and that done with the edge of a knife. Thus the crystallization is disturbed but little and air bubbles are eliminated. The plaster is now carefully worked into the tooth impressions by means of a camel's-hair brush, beginning with the molar on one side and

following around until we reach the opposite side. The remainder of the impression is then quickly filled with plaster, and worked into a cone-shaped mass, inverted and placed squarely and firmly upon a clean glass slab. If care is used here, much labor is saved, because you may calculate quite nearly the height of the capital or base. When sufficiently hard, and before removing the impression, we trim neatly, as shown in Fig. 3.

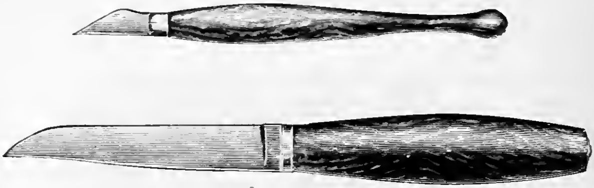


Fig.4.

Fig.5.

By following this method the delicate surfaces of the model are protected during the roughest part of the trimming. In this illustration we can notice the thickness of the capital already shown.

Fig. 4 illustrates the instruments used in trimming. The smaller knife is used for cutting grooves and prying away the sections.

Following this trimming the grooves are carefully cut until the coloring matter is reached. (Fig. 5.) In prying the sections away the operator must bear in mind any irregularities, and pry in the direction least apt to cause fracture. When the work has been carried on thus far carefully and neatly, we will be greeted with a beautiful reproduction of the anatomical portion. Care must now be taken not to mar its beautiful surface, upon which little or no trimming is necessary.

Fig. 6 shows the appearance of the model directly after the removal of the impression; no trimming or retouching has been done to its anatomical surfaces beyond the removal of the small bits of the impression from the inter-dental spaces.

With the anatomical portion of the model completed at this stage we next turn our attention to the trimming of the capital and base. These must be trimmed to give aesthetic beauty to the model. Now these artistic portions to my mind, must always conform to definite rules.

Fig. 6.

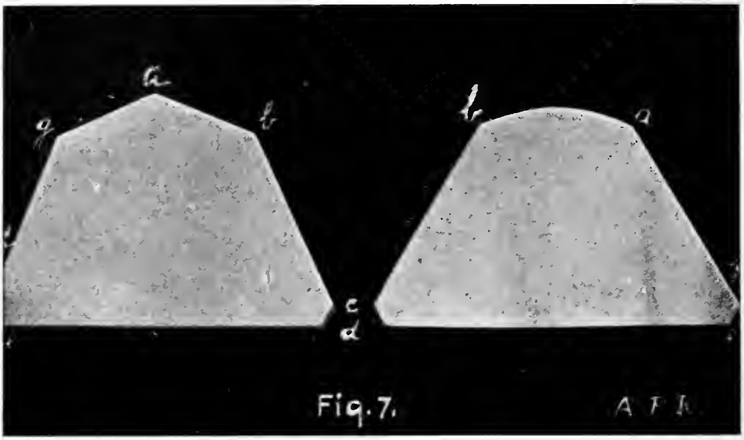
not always, perhaps, to the simple rules of plain perspective, but in every case they must conform to rules made imperative by the model itself.

Rules for Trimming Models.

Fig. 7 illustrates the general outline of the capital and base. To the left of the picture the capital is shown, to the right the base. It will be noticed that the base is trimmed identical with the capital, with the exception of the curve GAB which is used instead of the angle of the capital. In trimming these artistic portions the surface X is trimmed parallel to the grinding surfaces of the molars and bicuspids. While doing this we must consider the height of the capital or base, and trim down until we have placed them in right proportion to the anatomical part. This is measured on the section directly above the central incisor, and is usually about one-third or one-quarter the distance between the cutting edges of the central incisors to the extreme height of the labial space. (Fig. 11.)

The surface represented by ED is next trimmed; this must be parallel to the right and left tuberosity. This surface must be at right angles to the surface X, as indeed are all the surfaces that require trimming. BC and FG are trimmed parallel to the buccal surfaces of

the molars and bicuspids. The angles G and B directly over the cuspid teeth and the angle A directly over the frenum. The short surfaces CD and EF are trimmed at right angles to lines drawn from the angles G and B and are about one-quarter the length of the lines AB and AG.



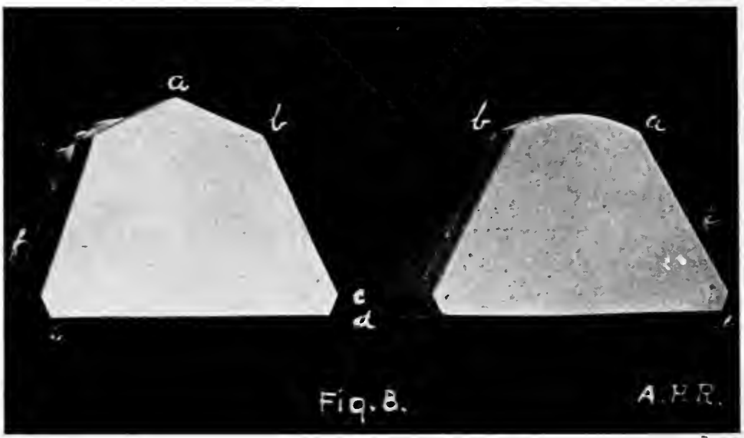
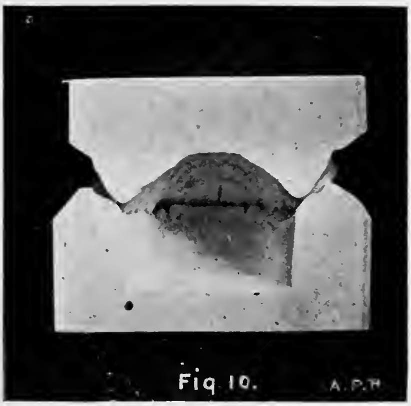


Fig. 8 shows the surface FG at right angles to the surface X. Fig. 9 shows the occlusal surfaces of the model. Fig. 10 represents the back view, showing clearly the lingual occlusion.

The rough trimming may be done with a very sharp knife, such as is shown in Fig. 4. When the rough trimming has been completed (Fig. 6), the model is gone over with a camel's-hair pencil and soft plaster, care-

fully filling all the air spaces and porous spots on its surface. The model is placed away until it becomes thoroughly dried, when it is ready for the final finish. To accomplish the most beautiful results, a fine, broad, flat jeweler's file is used with a rotary motion. When all surfaces are well finished, a slight bevel is placed around the entire edge.



Figs. 11, 12 and 13 represent different views of a finished model. Now if our work has been done with care and skill the result will be a beautiful and harmonious model, the reproduction will be exact and a thorough study of the case made possible. I wish at this point to emphasize that preparation is the foundation of all our success in orthodontia, because the habit of accuracy is here formed, and it is powerful in averting annoyances from early errors.

In this short paper I have by no means presented all there is regarding the subject, having left points regarding the repairing and preservation of models, as well as some details regarding the anatomical portion, but in doing so I have tried to impress the fact upon you, that when a good

impression is secured and properly treated the trimming of the anatomical portion of the model becomes unnecessary.

Doubtless many of you have valuable ideas which you have tried and proven. These we want brought out in the discussion. In this way alone

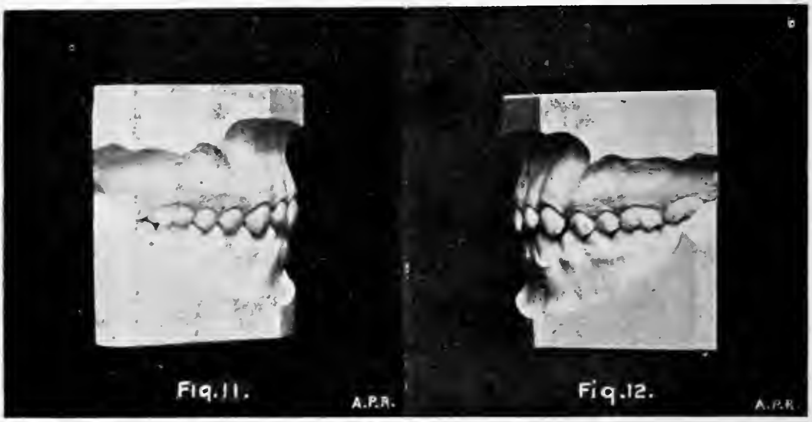


Fig. 11. Fig. 12.

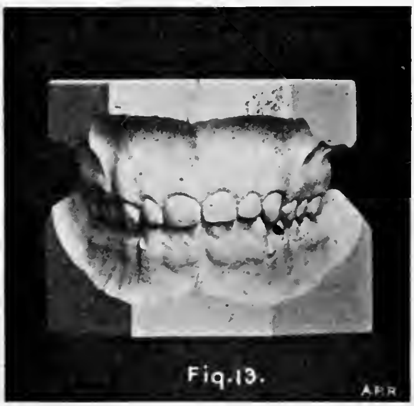


Fig. 13.

may a paper be made complete. In this connection I wish to acknowledge my indebtedness to Dr. E. H. Angle, Dr. J. Lowe Young, and others among you, for the use of knowledge learned in reading and conversation.

Discussion.

Dr. H. A. Pullen, Buffalo, N. Y.

It is with great pleasure that I have listened to such an extremely interesting and scientifically accurate paper. Those of us who have been connected with the American Society of Orthodontists

since its inception are especially interested in the paper because it shows to us that the methods used in model making have advanced considerably even since the first class of specialists received their instruction in this work at the Angle School, and also we feel that much of this advancement has been due to the ardent work of the members of this society.

The trimming of the capital and base of the models according to certain definite geometrical lines is not only the most artistic and best proportioned conformation of otherwise ungainly reproduction, but serves the very practical purpose of a standard for uniformity which enables the busy orthodontist to more quickly and consecutively follow out the definite rules for its treatment, than by the old and less accurate methods of model trimming.

There is only one thing that perhaps might be added to a paper which is so complete, and that is in connection with the artistic repairing of models which are defective through occasional careless manipulation. Cusps will sometimes be broken off, and there is a method of replacing them by the use of the knife and camel's-hair brush which I described in the September ITEMS OF INTEREST in 1900. I only mention it because of the necessity which arises for repair of casts which have been accidentally broken either in separating or by careless handling.

I wish especially to commend the class of paper which Dr. Rogers has presented to us for its accurate and scientifically concise descriptions of methods for the production of the artistic models which have been thrown upon the screen.

Dr. J. Lowe Young, New York.

I have enjoyed this interesting paper, and while I have few if any criticisms to offer, I wish to go into detail a little more than the writer has. To the members of this society, at least a majority of the members, I believe that it is perfectly clear; but this paper will not stop with the American Society of Orthodontists, but will go into print and stay there a long time.

I want to emphasize a point that Dr. Rogers made. That is, that we cannot have any definite measurement as to the length of the lines in the anterior part of the model which represents the artistic part. To make that clear, we will divide the model into the anatomical and artistic parts. The anatomical part should not be touched at all after removing the impression. That should be left perfectly clear. It should not even be touched with the fingers if possible. The artistic part is that which we work on and plane to certain definite lines. Now, as Dr. Rogers said, the length of these lines can only be determined by the anatomical part of

the model. Certain models need a wider base and a wider capital than others, and there comes in the question of balance. We must have the anatomical and the artistic parts of our model in harmony or they will not look right, no matter how perfect our angles may be.

The point he brought out, which I do not think has ever been written on before, of placing the plaster in the buccal and labial portions of the mouth with the spatula before inserting the tray, I think was first tried on my own mouth when Dr. Rogers was taking an impression for me. I have a pretty good lip pressure, and he thought it would be a good idea to force a lot of plaster in there to keep it out of the way, so he packed a lot in. I find this very valuable in lower impressions, but very rarely use it in the upper; but I believe he uses it all the time, and he certainly gets good impressions, as his slides have shown here to-day.

In describing the preparation of the impression prior to running the model he again omits detail. It is clear to us, but the general practitioner will not know whether to give one coat of shellac or two or a dozen. I think he ought to be more particular about that, and tell us how many coats of shellac he gives, and also the exact weight of shellac he puts to a certain number of ounces of alcohol. You can bring up the argument that the shellac solution is not staple, owing to the alcohol evaporating. That is all very good, but if you tell a man what is the right proportion, then if he is possessed of good judgment he will know when his shellac gets so thick that he ought to add alcohol.

In removing the impression from the model we should have a definite starting point if the best results are to be attained, and we should so hold the case that our fingers will not come in contact with the anatomical part. To do this, begin on the right side molar region if an upper, and the left side molar region if a lower.

He says the plane a, x, i, s, which is, we will say, the bottom of the lower model, should be parallel to the occluding surfaces of the bicuspids and molars. Now, I do not quite agree with that. I think that the plane a, x, i, s should be so that when the model is sitting level on a piece of glass or any surface even with the eye, that you have the teeth about in the position as you see them in the mouth, whether they are parallel or not. Then trim the rest of your model to correspond with that, along the lines that Dr. Rogers has given. I think you will have better appearing models if the plane a, x, i, s and the top part of the upper model are parallel.

Dr. C. A. Hawley, Cleveland, Ohio.

There is but one point in the making of models that I would like to discuss. The most important part of a model is the anatomical part, and upon its accuracy and smoothness depends the value of the

model. The greatest difficulty that I have had myself and have seen others have, is in the separation of the impression from the model. If it sticks too close, the model is almost sure to be cut and marred. It is quite difficult to know just how much varnish to use. If the varnish is thick enough so that when the impression is poured dry it will prevent the water of the plaster from going through into the impression, it is too thick and will destroy the fine lines of the model. Any plaster that is carried through the varnish with the water will make the impression stick closely to the model; but if the impression just before pouring is thoroughly soaked with water so that it is completely filled, and then the fresh plaster put in as the essayist has described, with a camel's-hair brush, there will be no leakage of the fresh plaster into the impression, and the separation is made much more easily and smoothly. Where wet plaster is poured into a dry impression there is almost always a firm adherence to the model.

Dr. F. M. Casto, Cleveland, Ohio.

The paper and the discussion of it have been very interesting and instructive to me. Perhaps nothing attracts the orthodontist's eye more than a case filled with beautiful models, made from accurate plaster impressions, producing a fac-simile of the teeth and anatomical parts associated therewith and having the bases skilfully carved.

I have spent a great deal of time working on models endeavoring to have them present a respectable appearance, and perhaps after I have satisfied myself upon the results obtained and cast my eyes admiringly upon the beautiful clean white surfaces, some fellow comes along and rubs his fingers over the surfaces, or in handling them yourself they soon become more or less soiled. What can we do about that? You can not hermetically seal them in cases so as to keep them clean. I would like to know of some method of treating models that would not destroy nor obliterate the fine lines and markings, perhaps some coating applied to the surfaces, which would allow of a reasonable amount of handling without ruining the models. I have used or tried a great many methods which have been suggested to me from time to time, but have found none satisfactory. I therefore appeal to Dr. Rogers, or any other member of the society to give us something that will protect them without materially changing their appearance. In his technique of taking an impression the essayist speaks of placing plaster with the spatula under the upper lip and on the buccal sides of the lower arch before inserting the tray. Now, if he will go a little further and put some plaster over the tuberosity and between the cheek and upper second or third molars, whichever the case may be, a good, accurate impression of that part of the mouth will be assured. It has often been difficult for me to get that

part satisfactorily because when the mouth is opened wide enough to allow of the insertion of the tray and plaster the muscles are drawn so tight against the tuberosity and second and third molars that the plaster will not be forced well up over them.

Dr. E. Ballard Lodge, Cleveland, Ohio.

In reference to this matter of the treatment of the impression before pouring the model, I would like to make a suggestion which perhaps will be of some value, and yet perhaps not new. Dr. George Wilson, of Cleveland, than whom it is doubtful if there is a better authority on prosthetic dentistry, makes use first of shellac and then of sandarac varnishes, and in the proportion of three drachms of shellac to four ounces of alcohol for the shellac varnish and three drachms of sandarac and four of alcohol for the sandarac solution. He allows the impression to dry thoroughly and then applies two or three coats of this shellac varnish to fill up the pores of the plaster of Paris. After this is dry he goes over it with one or more coats of the sandarac, which gives the model when poured a very beautiful and smooth surface.

Dr. F. S. McKay, St. Louis, Mo.

I was pleased with the treatment that Dr. Rogers gives the impression before it is even varnished. I take it he fills in the little imperfections as much as he can with the brush and soft plaster. I hoped he was going to tell us more in detail, as Dr. Young says, about the treatment of each surface of the model as he goes along.

As I understand it, he prepares the base first, and from that he gets the surfaces, one by one, at right angles to it. My method has been to prepare one surface at a time, and not try to trim the rest of the model to that surface. He did not speak as though he made any use of the plaster plane that Dr. Angle has recently perfected for us and put on the market, and if he has not, I want to tell him he has missed one of the most valuable instruments that has ever been given to us. I know, if you see it, you will find it surpasses anything else, and just to illustrate the surface it will leave on the model, I brought one or two of my own here to pass around among you. I do not understand his use of the file, and I wish, when he closes the discussion, he would enlighten us more on that point, just how he uses it, and what sort of a surface it leaves.

Dr. D. Willard Flint, Pittsburgh, Pa.

The essayist in speaking about the mixing of plaster said he stirred it a little bit. I think that we can leave out the word "little" and make it none whatever, and we would get better results. If you remember the reading of Dr. Lewis's paper at St. Louis, he made the plaster of Paris like rubber and drew it out in long strips, and said that we could get our best results by just letting the plaster of Paris absorb as much water as it will absorb.

Dr. William J. Brady, Iowa City, Iowa. There is another feature of model making that has not been touched upon in this paper and that is of value to us. It is not only necessary to make a model that is a correct anatomical record, and satisfactory to the esthetic sense by being pleasing to the eye, but it is also important that a model be trimmed correctly to aid in diagnostic purposes.

There is a universal tendency for the eye to be influenced in its judgment of lines according to the way those lines run and are related to other lines. This fact is observed everywhere, and all artists know of these illusions, as they are called. The architects of tall buildings remember this peculiarity, and when they place columns along a portico or facade certain of the columns are made to lean in at the top to make them appear perfectly true; they are purposely misplaced in order to give the appearance of correctness. We have the same thing to deal with. When we examine a model and try to determine what is wrong with it we are influenced in our estimate of the imperfection of that dental arch by the way the model is trimmed.

There is a certain line which is a very valuable one in this connection to aid in trimming the model, and that is the ridge found in the upper along or over the median suture. Usually the suture between the superior maxillaries is found in the median line or very close to it, and we trim our upper models to correspond to this and leave the same amount of plaster on each side of this line we have a much more accurate cast before us to make our diagnosis from. We cannot give a correct judgment as to what is wrong in a dental arch with an ill-trimmed model, and every aid should be used that will make our work easier or more exact.

Dr. A. P. Rogers, Fall River, Mass. In closing the discussion I wish to thank you for the keen interest you have shown and the kindly way in which you have carried on the discussion. Those who have criticised have done so justly, and those who have offered new ideas have added much to the value of the paper. For the benefit of readers who may be in doubt as to how many coats of varnish to use on the impressions, I will say that two of shellac and one of sandarac are usually enough when used so thin that the gloss does not appear until the last coat is applied. Regarding the use of the file I would like to impress upon you that one great advantage is that no matter how hard the plaster may become the beautiful surface may be easily attained. The file, of course, must be broad, flat, and very fine. It must be held firmly and squarely on the surface of the model and used with a slow and even rotary motion. The resulting surface is most beautifully smooth and hard and when produced by skilful hands is free from all imperfections.

The Ankylosis of Living Teeth.

With a Report of Successful Treatment of One Case.

By Rodrigues Ottolengui, M.D.S., New York.

In presenting this paper, I desire to say in advance that I am at the very beginning of the study of the subject. The views advanced therefore must not be taken as final, but rather as hypotheses, upon which I shall hope to attract the serious research of work of investigators.

It might be asked, why I have the temerity to present opinions, at the same time reserving the right to change them; the answer is, that I appear to have stumbled upon a subject of vast import, the real investigation of which will lead to untold advantages to both orthodontist and dentist. It is evident that the solution can be more rapidly reached through the combined work of many minds. With this apology for a paper that will appear but fragmentary, I approach the important topic of the ankylosis of living teeth.

The Ankylosis of Dead Teeth.

First, however, let us consider the ankylosis of dead teeth, for thus we may better comprehend the phenomena which occur. We are all more or less familiar with the so-called implantation of teeth. The term has been used to cover a variety of operations; the mode of fixation however, so far as has been learned, is the same in all cases. The extreme operation is the drilling of a socket, and placing therein a tooth from another mouth. If aseptically carried through in a healthy subject, and in a locality where the tooth may be entirely surrounded by a bony socket, fixation usually occurs in about twelve weeks. A marked characteristic of this union, which has attracted the attention of all who have seen such cases, is the peculiar sound emitted when the tooth is tapped gently with a steel instrument. I cannot better explain the difference between this and normal union than to say that the sound from the living tooth would remind one of tapping upon a plate made of wood, while the implanted tooth gives off a sound like the tapping on a plate of china. This is a diagnostic sign, of great value, as it is always reliable.

Another form of implantation, the opposite extreme, is where a natural tooth is dislodged traumatically, and is replaced within its original socket without alteration either of the root or the socket. Some have contended that reunion, and continued life of the pericemental membrane is possible in such cases. There is, however, no reliable history of such

a fortuitous result, and it would seem to be physiologically impossible. The pericementum cannot live without a blood supply, and the surgical mind cannot imagine the replacement of a tooth root so that all broken ends of capillaries would rejoin; nor can we imagine the formation of a new system of blood vessels. At all events it is enough to say that all replaced teeth which become firmly fixed, if successfully retained, give off the same diagnostic sound above mentioned.

In another condition, we have diseased sockets, and loose teeth, or abscessed teeth; men have attempted cures by removing a tooth, enlarging the socket sufficiently to rid it of diseased bone and then splinting it back into its own place. This operation varies from the first or true implantation in two ways; the tooth is the tooth of the patient; and the socket starts as a focus of disease, however thoroughly the operation may be performed. Prognosis is less favorable than in either of the other cases, and the final loss of the tooth by absorption is more certain to occur.

There is one other implantation operation, which, however, is the rarest of all—the removal of a misplaced tooth, and planting of the same in proper position. I once did this myself. A cuspid erupted entirely within the arch, apparently too far from line to be bodily moved to place. Nevertheless the space for its accommodation was present. I extracted the cuspid, and within half an hour had it replanted in a newly made socket in proper alignment. The new socket included no part of the old. Of one hundred implantations, performed by me fifteen years ago, this is the only one which I consider permanently successful, and it is still in position. A dentist in the Northwest courteously wrote to me about a year ago that he had been called upon to place a small filling in the tooth, and was astonished to be told its history. He reported it to be in good condition. How much this result was due to the fact that the tooth belonged to the body in which it was replaced, and that it was removed and replaced aseptically cannot be known. My own view is that it was a phenomenal result not to be taken as a basis for future practice. In the presence of modern methods the forceps has no place in orthodontia.

The Retention of Implanted Teeth.

This brings us to a necessary but brief consideration of the retention of implanted teeth. When the operation was first introduced I had the opportunity of making some studies of this question from sections made by Dr. Heitzman. Unfortunately slides were made solely from implanted teeth which had first become firmly adherent, and had been subsequently lost. Under these circumstances I recognized at that time what an advantage it would be to have a cross section of an implanted tooth with adjacent bone still attached in order to learn abso-

lutely the nature of the union. To this end I extracted from a cat a lower incisor, which had a lengthy root of small diameter. This at my request was implanted into my own jaw by Dr. F. T. Van Woert. The operation was successful; the tooth became firmly attached and was kept in the mouth for a year. It had been my purpose to remove this tooth, with its adjacent alveolus, by means of a trephine, thus affording opportunity for cross sections and proper microscopic study. Unfortunately an adjacent tooth became diseased, and grew so troublesome that it was extracted under an anaesthetic. Later I discovered that the implanted cat's tooth had come away with a part of the process necessarily broken out because of the excementosed condition of the root removed. The extractor knowing nothing of this had thrown the whole mass away.

I had no favorable place within my own mouth for the repetition of the experiment, but I have no doubt now that some of our enthusiastic students may make the attempt and procure the data for us.

The following may be stated with reasonable assurance.

The drilling of socket causes of course a wound; this is practically a traumatic injury. If no tooth were placed therein what would occur? Repair, which means a rebuilding of bone. Bone formative cells, known as osteoblasts, would appear, and the socket or hole would be refilled with bone. The placing of a tooth within the wound in no wise alters this attempt at repair as a primary effort of nature. But the presence of a foreign body arouses a new activity. In injuries to bone where there is penetration, with retention of the foreign body, as in a gun shot wound, or a stab with the breaking off of the point of the piercing instrument, nature first tries to be rid of the foreign body; it is released by a resorption of the surrounding bone until the foreign body is sufficiently loosened to be extruded. The cell which accomplishes this is a giant cell, the osteoclast, and the operation is termed osteoclassis. This course follows in implanted teeth, and we have a duplex phenomenon; osteoblasts building up the destroyed bony walls, and osteoclasts attacking the intruder; for in this instance, the intruder being bony in structure it is the foreign body itself which is demolished. The tooth root is composed of dentine, covered with cementum; and cementum is the part of the tooth most analagous with bone, since it is traversed by lacunae. The rationale of the union therefore is this; the osteoclasts are eating into, and thus roughening, the cementum of the implanted tooth, while the osteoblasts are rebuilding the injured alveolus. Should there be no infection, and should the patient's reparative energies be normal, the rebuilding will be more rapid than the destruction, and the new bone will be builded closely around, and adherent with the cementum of the implanted tooth. But

curiously enough there is another possibility, which if true explains the final loss of implanted teeth. There can be no permanent union between alveolar bone, and dentine; the interposition of cementum is essential. Therefore if the osteoclassis is rapid, and penetration of the cementum to the dentine occurs, there may be union of the surrounding bone with the cementum which is left, but not with the exposed dentine. At the points where the dentine was uncovered, the osteoclassis apparently is not entirely overcome, though probably its future action is retarded. Thus it continues, and by slow but sure degrees the root is eaten away, the rapidity of the destruction increasing in proportion as the area destroyed is made larger, thus affording chance for greater activity.

My authority for the above views is based upon specimens which I distinctly recall, made by Dr. Heitzman. In his examination of shed implanted teeth, bay-like excavations were found, the work of the osteoclasts. But many of these teeth having been removed had been torn from the socket, rather than removed by absorption. Along these areas, the osteoclastic bays were microscopic, and in them could be seen particles of true bone, but never any bony masses adherent with dentine. Similar examination of temporary teeth lost by resorption will never show any bays in the cementum filled with bone. Pericementum always covers the uneroded surfaces of the cementum.

Thus in brief, implanted teeth are held by ankylosis, there being a firm bony attachment between the cement of the root, and the bone of the alveolus. Thus, union being without interposition of any membrane, which latter normally acts as a deadener of sound, we get as a diagnostic symptom of such ankylosis, a peculiar sound upon percussion, likened to the striking of a steel instrument upon a china plate.

The problem for the orthodontist is: "If upon percussion a living tooth gives off a similar sound, is ankylosis present?" In other words, "Can there be ankylosis of a living tooth" and if so is there any cure?

Ankylosis.

Ankylosis of joints, in the living subjects, without death of the parts are common. There may be death or partial death, necrosis, of some part of a joint, and this may indeed be the primary cause of the ankylosis. We must then study the whole subject of arthritis, and joint ankylosis, to find some analogies upon which to base probabilities in the region under discussion.

Joints are broadly classified under the terms synarthrosis, amphiarthrosis, and diarthrosis. The latter are the joints permitting mobility; the elbow, ankle, knee, temporo-mandibular, hip, etc. The entire mechanical usefulness of the body depending upon the power of movement,

it is not strange that the immobility of these joints through accident or disease, has received more attention by surgeons than have the other joints. Hence it is from what has been learned about the etiology and treatment of ankylosis of diarthrodial joints that we may find a basis for theorizing in regard to the synarthrodial.

Diarthrodial joints are more or less complex in their anatomical construction, but the special tissue to which I would attract your attention is the sinovial membrane. The various diseases of this membrane, and the phenomena which occur when it is gradually displaced during the formation of bone which eventually unites the articulating bones of a joint by ankylosis are to be studied in order that we may seek analogies between ankylosis of mobile joints, and ankylosis in tooth sockets.

It is worthy of note that synarthrosis means without movement: that under this term are included subdivisions, such as the sutura, which of course are strictly without motion. But also the anatomists have here placed the gomphosis, which not only is not an absolutely immobile joint, but unlike the sutura we do find a membrane between the bony parts.

What is this membrane?

Some histologists have called it pericementum. If this word be taken as analogous to the word periosteum, then the function of the membrane should have to do solely with the cementum. Other histologists have thought that the membrane is composed of two layers one periosteal in character, and the other pericemental. Such writers prefer the term periodontium.

When we come to consider the phenomenon of ankylosis in this region, the following is a pertinent question. To what extent does this membrane serve the purposes of the synovial membranes in other joints, and, therefore, to what extent will it similarly respond to similar injuries or diseases?

Without awaiting the reply of the histologists, I venture to state as my belief, that the formation of an ankylosis in a tooth socket will not vary greatly from the routine in the other joints, except as the environment compels limitations. For example, we may exclude those forms of ankylosis due to adhesions of tendons or other soft tissues; but the true bony union between the bony parts, I think will not be found to differ greatly in etiology.

It is not my purpose here to take up any extended consideration of ankylosis of diarthroidal joints, but those interested will find it profitable to procure a monograph on this subject by the eminent surgeon John B. Murphy of Chicago, which may be found in the *Journal of the American Medical Association,* May and June, 1905.

It will suffice here to point out that while many ankyloses have their origin in a trauma, there are many and very serious varieties resulting from diseases, such as rheumatic disturbances; as well as the suppurative types which may follow typhoid, scarlatina, pyemia, etc.

By analogy then, in seeking a cause for ankylosis in living teeth we are to investigate traumatisms, and internal infections. Of the former there are abundant possibilities, including one of vast import to the orthodontist, viz.: "May we move a developing tooth to such an extent that a traumatic lesion may be produced, which may lead to an ankylosis?"

In regard to internal infections, the studies of Kirk and others, of pericemental abscesses forming on living teeth, already afford sufficient proof that we may have inflammations of this membrane, without death of the pulp. Similar infections of the synovial membrane may result in ankylosis terminating in complete union, with disappearance of the membrane. Why not the same course in the tooth socket?

A Case from Practice.

Let me now give the history of the case which I have to report. Some years ago I received a patient aged between eight and nine. The upper central incisors had erupted, but were slightly separated. The laterals were in course of eruption, but were deflected distally and presenting with wide spaces between them and the centrals. A rubber band around the two centrals drew them together within three or four days. A figure 8 band was then thrown around the two centrals, and supplied an anchorage for the mesial movement of the laterals. To this figure 8 band was soldered a gold wire, with screw thread cut on the ends which were extended so as to reach and overlap the laterals. Each lateral carried a band on the labial face of which was a staple. The ends of the gold wire passed through these staples, and nuts were then used to gradually force the laterals into alignment. It should be remembered that the laterals were but partly erupted, and consequently pressure was applied guardedly, which is proven by the fact that this apparently simple operation covered about four months of time. The four teeth were thus nicely aligned, and a fixed retainer was worn for a year, when the case was dismissed.

Last year the young lady was brought to me again, now aged fifteen. Examination showed that one central incisor appeared to be but half erupted, causing a conspicuous deformity. Percussion showed a marked difference in sound from that given off by the adjacent teeth. A diagnosis of ankylosis was made.

As to the cause, the patient and her mother insisted that the shortening of the tooth was due to the too early attempt to regulate the teeth. In this view, the mother declared that she had the support of "celebrated dentists, both in Europe and America." All my confreres apparently

blamed me for the condition. I could obtain no trace of any history of traumatism, of the ordinary character; that is there was no recollection of a blow, fall, or any other disturbance of the tooth in its socket. It had never been loosened, not even by my regulating apparatus. A query of vast importance to us all is here to be answered. "Was this ankylosis attributable to the too early regulation, or to the manner of doing the work?" To properly determine this please do not overlook the following facts. The centrals were but slightly moved, scarcely more than is commonly done when separating for inserting gold fillings. This transit was accomplished within a week, after which the teeth were used jointly as an anchorage for moving the laterals. The laterals were moved a considerable distance. The teeth were properly aligned, and retained for a year, and the case when dismissed, a year after all movement had been completed, was in satisfactory state. Subsequently, either the three other teeth continued to develop in length, while the one tooth remained stationary, or else the ankylosed tooth was driven up in its socket. I am inclined to the first theory, that of arrest of eruption of this tooth, with progressive eruption of the others.

The next point of interest is the fact that prior to coming to me the child had been given into the care of another practitioner, who worked several months in an attempt to elongate the tooth and finally abandoned the effort. By the means which I shall relate I may state here that the tooth was finally brought down into true position within six weeks. The other gentleman used the well known device, consisting of caps cemented on adjacent teeth, connected by a stout bar, and traction from this bar to the tooth by means of rubber ligatures. Please note that this traction is in the direction of the long axis of the tooth.

I must furthermore state that the patient declined to permit an X-ray, on the ground that her skin was too tender to be thus exposed. In this the family was supported by a skin specialist, so that I could not argue the point. Because of the fact that I was supposed to have caused the deformity, I was anxious to attempt a cure, even under these adverse conditions.

Treatment.

Having decided that ankylosis was present, I argued to myself that the tooth if moved at all, must be moved first *laterally* rather than vertically. I likened the condition to that of a screw in a board. A nail in a board may be withdrawn with vertical force, provided the leverage be great enough. The same force would fail to start a screw, whereas, movement of the screw laterally thus breaking up the attachment by enlarging the hole, will permit the withdrawal of the screw finally, with even less vertical force than was required to extract the nail.

In applying this principle to the tooth in question, I concluded that some vertical traction might be used however, coincidently with the lateral stress. The procedure was as follows. A platinum band was adjusted to the short central so accurately as to just reach the gum margin. The slightest exposure of enamel between the upper edge of the band and the gum margin would thus be the first sign of elongation of the tooth. To make this certain it was obligatory that no ligatures should pass around the tooth, thus possibly forcing the gum away and leaving me in doubt. To this band was attached a wide staple, high enough to just allow the passage of the finest wire. D bands were placed on the molars, with the tubes so pointed that the expansion arch when in place would fall below the incisive edges of the incisors. If this were then drawn up and lashed to the staple on the short tooth, vertical traction would result. The arch however was at first bent upward near the cuspids so as to cause very little if any vertical stress. When lashed to the central, lateral pressure was exerted by tightening the nuts in the tubes. Within a week slight lateral movement had occurred, and it became evident that I would succeed in breaking up the ankylosis. The arch was then made straight, and full vertical pressure applied, while heavy lateral pressure was also kept up. The patient was required to report immediately should any soreness result. This, however, did not occur. At the end of the fifth week a narrow line of enamel showed above the band, and I felt assured that the ankylosis had been overcome and that the tooth was elongating. The diagnostic sound on percussion had changed, and the sound emitted was the same as with the adjacent teeth. So certain was I that the tooth was moving, that I feared to continue the extreme pressure. I therefore again bent the arch, so that should it draw the tooth down to the limit of the tension of the wire, the tooth would be just the proper length and be it noted, there would then be no further tension. All lateral pressure was abandoned. That this precaution was wise was shown by the result. The patient was dismissed for three days, but was found at the office at eight thirty the next day, in a great state of excitement. The tooth was fully erupted. An examination was made to be sure that there was at that time no further tension of any sort, and that the appliance was simply acting as a retainer; assured of this the case was left severely alone for four or five days and a retainer was then placed.

A curious after result, may possibly lead us to an explanation of this singular case. Within three weeks of placing the retainer the patient returned to me reporting that the fixture had "broken." I found the band around the treated tooth partly severed by contact with the lower

incisors, and after considerable catechism discovered that the girl grinds her teeth together during sleep. As this particular tooth was originally slightly malposed, lingually, is it possible that during this act, she caught the incisal edge during this night grinding? If so, did this cause an irritation followed by an inflammation of the pericementum sufficient to result finally in the ankylosis?

Previous Reports of Ankylosis.

I have only been able to find one mention of ankylosis in the literature, and this is of interest. It is on pages 304-5 of Dr. Jackson's "Orthodontia." He reports a case of a lady aged twenty-three. The central was shorter than the other teeth, and the patient declared it had been fully erupted. This patient is at present in my hands. Jackson says the history was obscure, but that he finally learned that there had been a blow on the tooth. I have failed to get any similar admission from the patient. Jackson further says, "From a radiograph it was found that the root was straight but that no adhesions were perceptible, but it was evident, from the ankylosed condition, that the peridental membrane had been injured, and in the healing process a bony deposit had taken place connecting the tooth with the process." The above statement is very interesting. Dr. Jackson made a correct diagnosis, yet has not here or elsewhere in his book really discussed this highly important subject of ankylosis. Nor apparently did he appreciate the value of lateral stress in such a case. He describes his efforts at correction and declares that though the tooth had been elevated slightly it was not in a satisfactory position at the time of writing. It is now only a little more than half as long as it should be. Vertical traction in Jackson's hands applied with unusually powerful methods, failed to move the tooth. The fixation is so great, and the ankylosis apparently so extensive that it is only fair to Dr. Jackson to say that success of any effort to move this tooth is very doubtful.

Radiography of Ankyloses.

Dr. Jackson tells us that radiographs did not show the adhesions. This brings us to a most important feature of such cases. If we could but know exactly where the adhesions are, and the extent thereof, we would more intelligently work in the treatment. I believe it doubtful that much if any ankylosis can occur along the labial aspect because of the thinness of the bony plate. Osteoclassis sufficient to eat into the cementum, would destroy this plate, and infection supervening would bring about a pericemental abscess, a view borne out by the fact that all pericemental abscesses thus far reported have had fistulae opening through the labial or buccal gum. This leaves us three sides of the root on which to look for adhesions—the two approximal sides, and the lingual.

If the adhesion is along the approximal sides, the radiograph should show it; but the radiograph must be made with this particular point in view. As examples of what I mean I will show you radiographs of this case, which as Dr. Jackson says do not give evidence of the adhesions; then I will let you examine others which do. The whole diagnosis depends upon procuring a picture of the tooth, and adjacent teeth which clearly define the pericementum. It is evident that as the pericementum allows a freer passage of the light ray, than do the bony parts, the radiograph or let me for a moment call it a shadowgraph, should show a denser line around the tooth, than elsewhere. A clearly defined line of this character around a tooth indicates a space between the tooth and its socket. At any place where this line is absent theoretically there should be a union or at least very close juxtaposition of the root and alveolus. But diagnosis may be obscured by the character of the X-ray picture. The film must be developed to great density, in order to show great contrasts of light and shade. A dense film of this sort cannot well be examined by ordinary light but becomes very clear with the aid of a contrivance devised by Dr. Van Woert, which I have the pleasure of showing you. He has taken the ordinary fluoroscope box and replaced the end with thick cardboard, in which he has arranged a hole and pocket for carrying the film. Looked at in this way, all other light being kept from the eyes, very dense films are easily examined.

There are many interesting side questions in connection with this topic, and I may find opportunity to express more of my views during the discussion, but I have made this paper already too long.

Discussion.

Dr. Edward H. Angle. I am interested in this paper because it treats of problems novel and unique in the physiology of tooth movement. Yet I must tell you frankly I am a little skeptical as to there being such a thing as ankylosis in these cases, yet Dr. Ottolengui's evidence is quite convincing. If there is such a problem it is remarkable that the cases should be so very rare. However, I have had one or two cases where the teeth must have been ankylosed, if there be such a thing, for I know that they resisted all the force that I could apply, and that, too, by the best mechanical means I could devise.

I will describe one case which should be of interest for it has, incidentally, something to do with an important point in the history of one of the mechanical phases of orthodontia.

Many years ago a very beautiful young French lady was referred to me for the treatment of a central incisor which was fully one-eighth of

an inch shorter than its companion. In other respects the young lady's teeth were as near the ideal as I have ever seen, both in pattern and in occlusion. The lady inquired anxiously if this defect could be remedied and how much time would be required. I assured her that it could be remedied, and was quite positive that four days would be ample time (I was younger then). Well, I designed what I thought was a very neat, beautiful and efficient appliance. The tooth was banded and a button soldered to the labial surface of the band which engaged a delicate rubber ligature buttoned over a delicate cross-bar attached to bands on the adjoining lateral and central, all as shown in some of the early editions of my book. I remember how neat I thought it looked, and how satisfied I was that it would do the work. During the night I got to worrying for fear it might elongate the tooth too rapidly, and strangulate the pulp, or worse still, that the tooth might be forced nearly or quite out of its socket. But when the lady called again, to my great surprise the tooth had apparently not moved a particle. I put on an extra ligature, and after three days could still detect not the slightest movement of the tooth. Then I put on a third ligature. When she came again there had still been apparently not the slightest movement of this tooth, but the central and lateral used as anchor teeth had been forced perceptibly deeper in their sockets. I remember how this worried me and how fearful I was that they would remain so. You see I was a good deal younger then. So I enlisted the anchorage of two more of the adjoining teeth, and imagine my great surprise when they, in turn, were also depressed in their sockets. Well, I felt worried and humiliated, but not whipped, and I began to grope about for other means of anchorage, and the thought flashed upon me, "Why not extend the ligatures to buttons upon a bar attached to bands on the lower teeth?" Of course this was in sheer desperation. I did not suppose the young lady could then either talk or eat—but I was much younger then. In reality the wearing of this additional ligature annoyed her but little, and this, gentlemen, was the origin of the intermaxillary anchorage. It is illustrated on the case in question in the early editions of my book, and was also published in the Cosmos. I saw it was good and soon applied it in many other ways. But as to the tooth in question—notwithstanding all of this force being exerted, not the least particle that I could detect did it move. Instead of the promised four days, the operation had been prolonged into two anxious months. Gradually doubt had crept into the mind of the young lady, and doubt betrayed her over to skepticism, and skepticism to disgust, and disgust to the display of a temper that is said often to accompany black eyes, and the use of certain French words the meaning of which I never knew; but I have always thought

that probably they would not sound well in church. She left my office and vanished into the unknown and I never saw her afterwards.

I had never heard of an ankylosed tooth at that time, but never gave up speculating on the condition of that tooth. Now Dr. Ottolengui has helped me out. I had figured that the tooth must have a root like an enormous corkscrew, and that it wound straight up and was grown firmly to the parietal bone, but Dr. Ottolengui has greatly relieved my mind, and probably given us the true solution, and I hope we will all have our microscopes out for teeth in ankylosis and rapidly learn more about them.

Dr. O. W. White, Detroit, Mich.

I would like to ask Dr. Ottolengui if the new bone absorbed, and if there had been any absorption at the root why wouldn't some anchorage occur again when it is brought down? I understood the doctor to say that when the tooth was brought down he had the same sound as from a normal tooth. In time wouldn't some growth take place there again?

Dr. Robert Dunn, San Francisco, Cal.

I would like to report the case of a gentleman forty years of age where the superior cuspids erupted lingually, and in trying to bring them down the right cuspid was moved down without any difficulty, but the left as Dr. Angle has said, resisted all anchorage, and to-day I am trying to find out some way to bring that cuspid down.

Dr. George C. Cook, Chicago, Ill.

There are two or three points in the paper that are interesting to me. I have made a number of slides of decalified tissue, where the teeth had been extracted removing large portions of alveolus, and you have perhaps all seen many times that it is very hard to take off a piece of tissue from the cementum of the tooth. I never thought these slides would be of any special interest other than for my own curiosity, but there is a strange tissue change which takes place, which I think is decidedly different from that of ankylosis in synovial membranes. The synovial membrane, of course, is very different in its microscopic aspects from peridental membrane. Dr. Summa has spoken of radiating connective fibers in the peridental membrane. Both of them are elastic tissue to a certain extent, and it seems to be a physiological fact that tissue of that nature when disturbed is very likely to assume another physiological function. The physiological function is changed to the extent that there is a gradual deposit of lime salts in that connective tissue which goes on until you have a permanently formed bone that develops into normal bone tissue inasmuch as apparently the lime salts have been laid down

from two sources. Why it should come apparently from the cementum of the tooth is something that I am not able to give any explanation of, but apparently they unite. There is sometimes a definite line apparently formed right in the center, we might say, the longitudinal center of the peridental membrane. The changes are not sufficient to do away entirely with all of the elastic tissue, but there is enough calcific deposit from the alveolar portion of the cementum to make sometimes a permanent bone union, and instead of the bone union being removed from the cementum the union between the cementum and this newly formed bone structure is of such a nature as to tear away or break down a large portion of the alveolus, perhaps, in order to remove that tooth.

Dr. Ottolengui spoke of teeth that were replanted. I have made a number of examinations of tissue of that nature, and there is a tendency to take on the cell function and assume a condition in which it is capable of absorbing. The osteoclasts are simply cells whose functions are changed. They are the same cells, only in a changed condition. They have a tendency to absorb the calcific deposit. They would not attack any other substance than that of the inorganic salts. An illustration may be drawn like this: Certain trees grow on stony places. Their roots form a substance that will destroy the calcium in the rock, and therefore they get nutrition from the rock itself, rather than taking it from the earth. Those trees may be transferred from those stony places into soil, but you must furnish them a substance which they can break up, for the time being, at least. The so-called osteoclasts take on the function of destroying calcific material, and in so doing they form these notches, but I doubt from the microscopic examinations that I have made whether they have anything to do with the stability of the tooth.

The question that arose in my mind as to the breaking-up of that ankylosed condition was whether irritation had been established in this live tooth by some form of action in which this change had taken place in these elastic fibers. They no longer were elastic fibers, but had changed their function to fibers of calcification, and the more irritation you put on there the more likely it would be to become more active in the formation of the calcified condition.

Dr. Ottolengui. I am going to advance one more theory as to the possible ankylosis of that tooth. It is apparent from the casts that the tooth in its original condition in babyhood was longer than when it returned to me in its ankylosed condition. It seems likely that it has gone up in its socket.

Let me speak of a peculiar experience I had in the implantation of a bicuspid. The tooth appeared to be soundly attached, and occlusion was

correct. In about three months the patient returned for other work, and to my astonishment I noticed that the tooth was too short for occlusion, and still firmly attached. Six months later the tooth was only half its normal length, and still firmly attached. A year after that she came in and showed me that there was nothing of the tooth in sight except the cusps protruding from the gum. I extracted it. My only explanation of that is that the union was of such a character that it did not resist the force of mastication. In brief, there is contact of the morsal surface of the tooth with a foreign body of food, which may be sometimes very hard, and it was my opinion in that case that the tooth had been driven up in the socket because the union was not sufficiently firm to withstand the stress.

When we move the teeth in our operations we certainly loosen them. We expect that the alveolar tissues will resume their normal density, and that solidification around the sockets will recur. Suppose it does not occur? Then we would have the forces of mastication acting on the teeth and possibly causing some inflammatory action which may result in a cementitis, or some inflammation which starts the bony deposit.

Let me state why I think that lateral pressure will accomplish something when vertical pressure may not. I think in vertical stress the resistance is too great for the stress to cause the re-absorption of the normal tissue around the ankylosed portion. I think if I could take an X-ray, that the tooth would still have this attached bone on its side which originally caused the ankylosis. In moving it laterally you are dragging the ankylosed tissue away from practically a very weak attachment. If you drag it vertically you are endeavoring to move it the full distance of the ankylosed territory.*

An adjournment was then taken until Friday morning.

Heredity as an Etiological Factor in the Production of Malocclusion.

By Martin Dewey, D.D.S., M.D., Kansas City, Mo.

Heredity as an etiological factor in the production of pathological and abnormal conditions, has always occupied a more or less important place

*At the time of sending the above to press, one year after treatment of the case reported, I am able to answer the question of Dr. White. I should have said, at the time of the discussion, that re-ankylosis would be a normal expectation. However it did not occur in my patient. The tooth has remained mobile in its socket. R. O.

in the medical and dental world. In early writings we find that prominent men have cited heredity as causing almost any pathological condition from carcinoma and tuberculosis to simple inflammation of the mucous membrane. As the knowledge of medicine advanced, as it became a more fixed science and guess work has been eliminated, we find the theory as to the influence of heredity has changed.

Among the late writers and investigators we find very few conditions are attributed to heredity. Even insanity, of which at one time there was no doubt that it was caused by heredity, is now considered by most men as the result of environment. If we remove the unfortunate individual, which the world has seen fit to brand with inherited insanity away from the surroundings which have been instrumental in producing the insanity of his family, and eliminate other factors, we find the tendency to the disease passes away. There was little doubt in the minds of old writers that tuberculosis might be inherited. Did they not see generation after generation practically wiped out by that dread disease, consumption? Of course they supposed it was the result of inheritance, and when Koch discovered and stated that the disease is the result of a germ contracted from surrounding conditions the world was slow to accept the discovery until it had been proven beyond question.

The discovery of bacteriology, the development of pathology, and increased knowledge in physiology and embryology have overthrown one theory after another as to the influence of heredity until now it remains in most cases as a past theory along with "laudable pus" and "the worm theory of decay." As one eminent writer said, "the development of modern embryology is a terrible blow to the theory of heredity.

Influence of Heredity on the Face.

As steps in the development of the embryo is noted and we see the gradual and slow growth, little room is left for heredity to play an important part. As we note the union of the two germ cells, the characteristic substance of which is chromatin, it is there that we must look for the influence of the force which the world terms heredity. The germ cells contain properties of both male and female, such as to produce the race and type, but further than that we can not go, and attribute certain malformations to heredity, as some are prone to do. We find much said about the laws of heredity and their influence in the production of malocclusion, but very little is said as to what those laws are. We find there are certain laws of heredity, but they are such as tend to *diminish* rather than *produce* malocclusion.

What, then, are the "laws of heredity," to which writers refer in speaking of such cases? One of the classes of cases which they speak

about and claim to be the result of heredity is where the individual is said to inherit the large maxilla and mandible of one parent and small cranium and face of the other. To the patient and layman such a statement seems plausible, and many a dentist has posed as a scientific (?) man while advocating such a theory, for theory only it is, as I know of no one who has produced such a case and proven it to be true. If you stop to analyze such a case as result of inharmonious inheritance the first question is how would it be possible? As we study the development of the embryo and see the bones of the head and face as they are formed from the cells of the mesoderm it is impossible to say which cells form certain bones and which forms some other, but as the process of nature proceeds we see certain bones develop in cartilage and others in membrane. There is always a harmonious relation existing between these parts. Why should nature develop the bone in a growing structure which is too large while developing by its side would be one which is too small? One would think from the writings of some authors who treat the subject of heredity as producing inharmonies of the bones of the face, as well as malocclusion, that the growth of the embryo proceeded along the same lines as that of the construction of a machine. That instead of the embryo being developed by a natural growth resulting from the union of two separate cells that nature chose from parts already formed; that in the rush of life nature chose parts that did not harmonize. That nature chose the ready-made jaws of a large parent and used them with a small face of the other parent. How else could such a condition take place as jaws too large for the face?

The bones of the head and face, with the exception of the mandible are so closely and intimately related that it is impossible for one to assume too great a size without affecting the other. I again ask how the development of such a condition is carried out?

They are so arranged and articulated that for one to be too large, the entire osseous framework of the head and face would have to be made over. The bones would have to be rearranged and replaced in order to make them fulfil their proper function. And where is the man that can point to any such marked change as would be necessary to make this inheritance of misfit jaws possible? How does it occur?

Large Teeth in Small Jaws.

Likewise the old theory of large teeth in small jaws. How does that occur? Advocates of the theory say that the child inherits large teeth of one parent and small jaws of the other, but they fail to show how this is possible. They see teeth which are crowded because of one or more of many acquired causes. Also the teeth may appear large

because at the time of the eruption the teeth are full sized and the features not fully matured. In other words the teeth which are the same size as in an adult, are noted in the face of a child which, of course, causes the teeth to appear large.

Some acquired cause is present which produces malocclusion and is the direct cause of the "irregularity." Instead of looking for some direct cause the writers who believe in the theory of inheritance of large teeth and small jaws in attempting to support their theory of crowded teeth in arches which are not developed, say that "it has been given as a reason for this condition that a child may inherit the jaws of one parent and the teeth of another, then for the lack of a better explanation it may be well to accept this for the present."

We know that in science an affirmative or a negative statement proves nothing. Nevertheless we find men standing high in the dental profession, and who would pose as authorities on orthodontia, making such a statement, as "for the lack of a better explanation it is well to accept this one for the present."

The question in my mind is, can it be accepted in the face of other knowledge? The child might inherit the small jaws and large teeth if the teeth were ready made and placed in the arches; or if the individual were constructed from certain parts of one parent and corresponding parts of the other we might find an inharmony of parts by improper selection, but the embryo is not formed by the assembling of parts selected from each of the parents, but development takes place by the division of a growth of cells and each organ of the structure is formed by those cells as growth of the embryo demands. We find up to a certain time it is impossible to say which cell will form this organ and what cell will form some other. Neither can we tell up to a certain time which cells will be used in the formation of the jaw, and which one will go to form the tooth. As the growth of the embryo goes on, and we find certain cells forming the dental papilla which becomes a tooth germ, and the other cells which lay next to it, sister cells in fact, and were entirely the same until nature called them, go on and form the jaws. The tooth, with the exception of the enamel, and the jaws, are developed from cells which were exactly the same up to the time of the special development. We find they were cells which lay side by side, sister cells which were formed by the division of a mother cell, one of which will be used in what later develops into a tooth and the other will be used in the growth of the jaw. How then occurs the awful inharmony which we hear about? How this inheritance of large teeth and small jaws when you find the teeth are developed along with the jaw?

All cases of large teeth and small jaws which I have heard about have always been in the permanent set. If such a condition exists in the permanent teeth, would it not be reasonable to expect to see as many in the temporary set?

If they are seen why are they not reported? As they have not been reported I conclude they are not seen. If inheritance plays such an important part in producing malocclusions of the permanent set would it not be reasonable to expect the temporary teeth to be affected as much as the permanent ones, as the framework of the temporary teeth is formed and jaws developed in utero when the influence of heredity has more of a chance to act than in after life when other environments are present. If such inherited conditions do not exist in the temporary teeth would it not be well to look elsewhere for the cause of a condition that is not seen until the permanent teeth erupt and many environments and acquired causes have had a chance to act?

Heredity has been held as producing a type of cases known as family traits. By that is meant some form of malocclusion which is found in the parent and is also present in the children.

Malocclusion not Transmitted.

This type of malocclusion, which has been classed as family traits, may be anything from the rotation of a single tooth, to cases of protrusion or retrusion of either the upper or lower teeth, pro or sub mandibular development. In fact all of the different class of malocclusion have at some time or other been attributed to family traits.

Very often when we are examining the teeth of a child the mother will inform us that the child's teeth are like the father's, or in other cases it may be like the mother's. In most cases if the teeth of child and parent are examined we will find no more similarity than is found in any other case of malocclusion in which there exists no relationship. In other words, we do see similar malocclusion in parent or child or in children of the same family. We may have a bunching of anterior teeth which are similar, but is that proof that family traits are responsible?

Men who advocate the theory of family traits and inherited malocclusion point to the children who have the same facial outline and general build of a parent. While a child may inherit the build and facial contour and makeup of the parent, such characteristics as speech, walk and mental disposition, are acquired from association with the parent rather than inherited.

Effects of Environment.

A type of malocclusion which is often considered as a family trait is that of Class 2, of either Division 1 or 2. One or both of the parents will have retreating lower jaw, teeth and chin, with protruding upper;

and one or more of the children will have the same malocclusion. Of course, the parent and some dentists can see in this a clear case of family type; an indisputable case of inherited malocclusion. A careful review of the case in most instances yields a history of inflammation of the mucous membrane of the nose and throat, adenoids and nasal obstruction and mouth-breathing in both parent and child.

The history of the parent is the history of the child. What the child endures so did the mother. They were all raised in the same environment, brought up with the same plan of house-heating and ventilation, and all have been more or less sufferers of so-called "colds." An examination of nasal passages will reveal the same pathological conditions and still we are told that family traits are responsible for this and other types of malocclusion when environment and acquired causes have to be literally pushed out of the way and thrown aside in order to uphold the old theory of heredity.

Cleft palate and harelip have by some men been classed as the result of inheritance, but as it is a more noticeable deformity than the majority of malocclusion, men have given more time to the study of such condition and the collection of data, until at the present time heredity is thought to play no definite part in the production of the cleft palate or harelip. The deformity sometimes exists in several children of the same family, but no history of cases before may be found, nor is the deformity often seen in the children of parents who have harelip. It may be found in the children of parents who have harelip in *very rare cases,* but in the majority of the children it is absent. We find no trace of harelip or cleft palate being transmitted from parent to child in case even where the mother has suffered mentally by the dread and fear that the child would be born with either of the deformities. This has a tendency also to overthrow the theory of the nervous condition of the mother being responsible for malocclusion of the child, and the old theory of nervous influence should be overthrown, because, in the face of modern embryology, how can such a thing exist? We know that the nervous system of the mother and the child is separate and distinct. At no time in life do we find a nervous impulse of the mother being carried to the child. Not only do we have a lack of nervous connection, but also we have no arterial nor veinous connection. Not a drop of the mother's blood ever enters the embryo. The embryonic germ is free from the maternal structure as far as nervous or circulatory systems are concerned. It then follows that the influence of inheritance or force of heredity is found only in the ova and spermatazoa, and after the union of those elements there can be no more characteristics or peculiarities of the parents assumed by the embryo.

In the face of this evidence the question in my mind is: Is not heredity as an etiological factor in the production of malocclusion given too important a part in the minds of some writers?

I think it is. In the past the opinion of some men and their theories have been accepted until they have become to some so-called facts as to laws of inheritance. If heredity does play such an important part and produces malocclusion as is claimed for it, proof must be advanced, and not theories. As our knowledge of embryology, physiology and pathology have advanced, the room for heredity has been limited. The influence which it plays must be shown, and in showing cases which are supposed to result from heredity writers must acknowledge environment and acquired causes, and not name congenital condition as the result of inheritance; and when they so arrange their theories as to remove every reason of doubt, then will we be able to tell the exact influence of heredity in the production of malocclusion.

Discussion.

Dr. Burt Abell, Toledo, Ohio.

After what we had yesterday along this line from Dr. Summa and Dr. Noyes, and Dr. Dewey this morning, it seems almost an impertinence for me to attempt to speak on the subject. I agree with Dr. Dewey that there is never present these large teeth and small jaws, and I think he stated that the reason of it is because of this inter-dependence of parts; however, he has attacked the law of heredity, and it seems to me has confined it to one generation, which is hardly fair. I think we ought to give due credit to the laws of heredity in malocclusion. No one denies that there are extraneous elements which enter, but I do believe there are also hereditary influences. We really *know* nothing about it, and are compelled to judge from what we can find out in the laboratory, from what we can see in different cases, and from what we can reason from conditions existing in the lower animals.

The human body has always been taken as a type of beauty. I have been interested in reading Metchnikoff, who has charge of the Pasteur Institute in Paris. He states that in earlier times people had tried in art to improve the beauty of the body by adding wings and other things like that, but that they had to come back to the human body as the highest type of beauty, and yet he states that Weiderscheim has taken the trouble to look up points of inharmony in the different parts of the body, and has found one hundred and five different rudimentary structures that are not in use and that are out of harmony with their surroundings. He has found seventeen more or less rudimentary structures

still in use. He has found fifteen in which we are better off than our Simian ancestors. If I had time I would like to speak of the different features, but it is not advisable at this hour. I will name a few of them. The hair itself is one of the things handed down to us, and yet it is not necessary; the stomach also, and the colon. People live without them. Even the coccyx is just the remains of the tail of the lower animal. The muscles of the ear are rudimentary, and so on. These are all hereditary, and follow what I believe to be the law of type. A certain type is reproduced. I think Dr. Summa told us yesterday that this same law that would produce a type is constant in what we term family traits. It seems to me those are two terms, one generic and the other specific. There is one instance that is interesting. Dennecker had the advantage of studying the fœtus of the anthropoid apes. He found, up to the fifth month, there is a striking similarity between the fœtus of the ape and man; but then there comes a stimulation of the cells that form the jaws, and from that time on there is a growth away from what we see in man. In the bulldog we see the arrested development of the upper jaw. It seems to me there is the same law there, one handed down because of the type, the other handed down for a short time, because the bulldog is a modern product, so to speak. The great horticulturist Burbank at one time was near a bed of verbenas and noticed a fragrance that was never present before. He discovered among the many plants which one it was, and saving the seed from the plant, he is now giving us verbenas that have a delicious fragrance. We all know how that power of selection works in the lower animals. A certain feature appears, or by a certain union certain markings appear, as on the feather of a hen, etc., and can be perpetuated by intelligent selection.

Now this point occurs to me: Man has *always* been more or less afflicted with malocclusion. There has not been an intelligent selection, but, what we would call in the lower animals, a haphazard mating; consequently we have not had well-defined classes of malocclusion, so that we can not readily come to a conclusion along this line of heredity. I think you can not disregard the powers of heredity because that is the way we can trace back through the lower animals. Even granted that we may not directly inherit malocclusion, yet we inherit certain tendencies that produce malocclusion. For instance, in the class to which Dr. Dewey called attention, Class 2, Division 1, I believe there is an inherited condition which would influence or cause adenoids or hay fever, and the power of heredity might give an individual a certain constitution which would produce this particular malocclusion. A certain tendency on the part of an individual to do a certain thing by which he brought about a certain condition might produce a disease.

We have been told that it takes thousands of years to make an artificial condition hereditary, and the example was given of the bound feet of the Chinese women. That leads to this statement: The very prevalence of malocclusion is an argument that it is handed down to us from one generation to another, and that it is not alone caused by extraneous circumstances, or else that we would find no malocclusion except where we could definitely point to these outside circumstances. I believe we have no ground to condemn the influence of heredity until we have tried intelligently to reproduce malocclusion through the power of selection.

Dr. S. E. Dodson, Grand Rapids, Mich.

I have a slight knowledge of dogs, and can state that in early puppyhood the jaws are alike in development, but at about six months the upper ceases in its development, while the lower goes on. This leaves them in the same condition we often notice in orthodontia, Class I. You have an apparent protrusion (lower) when, as a matter of fact, there is an under development of the upper jaw as the *real* condition.

I would like to ask Dr. Dewey if he means to say that heredity is *not* a factor in the production of malocclusion? The trend of the paper appears to be that way, but it does not leave me clear on that point.

Dr. Lourie told us yesterday not to be too radical about the statements we make, because, as some one has remarked, they go in print and stay there for a long time.

For my part, I do not think it would be wise for us to wholly eliminate heredity as a possible factor in malocclusion. It seems to me that we do inherit certain tendencies. Dr. Dewey spoke of not inheriting insanity nor tuberculosis, which is probably true, in a measure, but I think every one will admit that you do inherit the tendency. On the other hand, it is well known that people are born idiots and imbeciles, when the environment could not have had anything to do with it. I think we have all seen faces that it would be very easy to produce malocclusion in.

I can heartily endorse Dr. Dewey's paper with the exception of his radical statements in regard to heredity.

Dr. Dewey.

Dr. Abell followed out the same line of argument which I tried to show you that the old writers followed. He failed to show you how the laws of heredity would produce malocclusion. Simply stating that such laws as this exist does not prove the fact. If those laws act it ought to be shown how they do act. We have a condition in lower animals similar to the one pointed out in man, the large teeth and the small jaws, and if that condition is to be found in man, why would you not find small

fingers on large hands? If you find it in man, why do you not find it in lower animals. The ovum and spermatozoa contain elements that produce a type of race, but we can not say that they produce pathological developments.

Dr. Abell bears out my statement when he speaks of the fœtus of the man and the ape, and says that they are the same up to a certain time. That shows that they are produced from two cells, and about the end of the fifth month there is a gradual change which takes place. There are laws of heredity, but they do not produce the abnormal, because as soon as abnormality appears it is not heredity.

In answer to Dr. Dodson's statement I will say that I do not believe that heredity plays any part in the production of malocclusion. Heredity produces the normal, but not the abnormal. Neither do we find inherited tendencies toward mouth-breathing. Adenoids and inflammations of the mucous membrane are the result of environment. The child may inherit the environment, but not the tendency to inflammation of the mucous membrane and mouth-breathing; neither does he inherit the disease known as tuberculosis. In regard to idiocy: We sometimes find idiots in the best families. We also find insanity among the old families of England, where the people were all born and brought up in the same section of the country. If a child has insanity, the family fears it, and it is brought about in other members of the family by fear. I think heredity, as an etiological factor in malocclusion, plays no part at all.

The Influence of Heredity on Malocclusion.

By William J. Brady, D. D. S., Iowa City, Iowa.

There is no part of the science to which we are devoted that is more interesting than the influences that inheritance may or may not have in the production of malocclusion. There is perhaps nothing in orthodontia that requires a deeper insight into the workings of nature and the mysteries of life itself in order to speak with authority, yet there is no part of our science concerning which more loose statements have been made, and many assertions have been accepted as correct that are in direct conflict with clearly established truths.

Some of the assertions which are unwarranted by facts have been made from little knowledge of the subject in any way; some from a misinterpretation of common facts whose true meaning may be easily arrived at; others from plain "jumping at conclusions" simply because a thing *seemed* to be so; and still others (and probably the greatest number) are from an examination restricted to the human race alone, in which the workings of Nature in other fields are passed by and the fact is ignored that Nature's laws are general and affect every living thing, and that she does not make exceptions for the animal, man, any more than she does for the humblest insect.

It is impossible to consider more than a small part of this vast subject in a single article, and the writer makes no claim of authority, nor

that his word is final. Our ignorance of Nature's ways and Nature's laws is too great for us to say that this or that is established from the observations or reasoning of any one man. In commenting on what has been said by others on the subject, all due respect is intended, for no doubt each contributor has said only what appeared to him to be the truth according to his views. Such facts and arguments as may be presented are offered with a sincere desire to arrive nearer the truth in the case, and must be judged as all others should be, entirely according to the light that the knowledge of the times affords.

Heredity and Environment Defined.

Before entering into any discussion of the subject, the underlying truths that have been established should first be enunciated. It is one of the most universal facts in Nature that every living thing from the highest to the lowest is subject to the action of two never-ceasing forces; the tendency to resemble the ancestors from which it came, and the tendency to be influenced more or less by its surroundings. The tendency to resemble ancestry is called heredity, and a character or condition that appears prominently through a series of generations is said to be hereditary or inherited. The surroundings of an organism are called its environment, and include every possible condition which might have any effect upon its development, such as food, climate, light, air, moisture, heat, cold, cultivation, artificial benefits, natural enemies, companionship, mental condition, method of living, exercise, in fact, any and all things capable of exerting any influence for better or worse.

These two forces operate entirely according to natural laws, concerning which our ignorance is most profound. In fact, we comprehend only a few of the most easily recognized details and have only the most general knowledge of the workings of these forces which influence all life. However, our knowledge of these general laws may be of great service in solving some of the problems of orthodontia if reasonably and intelligently applied. A few of the important general facts applying to the influences of heredity and environment have been selected, and their elaboration and application to orthodontia will now be attempted.

Limitation of Heredity.

While the influences of heredity and environment extend to all life, yet there is a limit to the effects of each tendency. It is well known that while heredity tends to produce offspring resembling the ancestors, yet there is a certain amount of elasticity in the rule. Like produces like, but not exactly like. The likeness never amounts to identity, even in the closest resemblance; there is always some variation. This variation may become intensified by environment, and by long repetition of the intensifying process the changed conditions become regularly repro-

duced and thus hereditary. It is upon this fact that the many varieties and species occurring in all life depend. The influence of heredity never allows a violent change, however, nor a wide departure from any established form. There is a limit to the exact resemblance maintained by heredity, and also a limit to the change that may be produced.

The influence of environment is likewise marked by bounds. Environment influences all growth and development, yet the surroundings will never change an organism from one type to another, at least not through any period of time with which we have to deal. No amount of cultivation will change the cactus to an oak tree, though it may be robbed of its thorns and made a useful plant of the garden instead of an outcast of the desert. Goldfish of many varieties have been produced by patient selection and breeding; yet the goldfish will never be anything but a fish—never a bird nor a mammal. Yet on the other hand the influence of environment affects every form of life in some degree, and may affect it more in a short time than we are aware. No man is wise enough to predict the effects of environment if continued through eons of time, and no man lives long enough to observe more than a very little concerning the limits of either environment or heredity.

When we begin the study of any organism, we should first consider the conditions under which that organism as a whole rose to its present form, and then whether any particular part is the regular product of long inheritance or the result of some recent environment. It will not do to take for granted that things are in their normal condition just as we find them. It must be remembered that any form of life which we investigate has been in existence for ages, and that we as individuals are very late arrivals on the scene.

Reversion to Type.

Not every condition we find is the result of heredity. A like environment may hold an organ to a like condition for successive generations instead of heredity being the compelling cause. When this changed environment is relinquished, heredity quickly changes the organ back to the old form, and holds it there again perhaps for centuries with only such permanent variations as the force naturally allows. Heredity is the force that holds all life to its true forms through the ages, and its power is not set aside in a few years even under an intensely changeable environment. The influence of heredity must not be judged by the condition of a few individuals nor a few generations even. All this is seen in many common instances. The farmer must keep continually selecting and improving the seed for his crops, or they soon run down both in quality and in yield. This is simply an exhibition of the power of heredity asserting itself on the least relinquishment of an artificial environment, the

grains tending to return to the original wild forms whence they came, and to what was their normal condition for untold centuries before man began their cultivation. The rose when deprived of the loving protection of man becomes a wild rose again. The $30,000 Lawson pink becomes a ten-cent carnation if left to itself.

The same thing is seen among domestic animals. Our improved cattle must constantly be kept up by selection and infusion of new blood, or the quality deteriorates and scrub cattle result, a return toward the primitive forms of ages ago, and the return is vastly more rapid than the advance. This same thing is seen on every hand, and the same results are obtained by every like experiment. Whenever environment relapses to a former state and artificial selection of sex or condition ceases, heredity asserts its power by a return to the condition under which the type of animal or plant was established, and which, speaking in a broad way, may be considered its natural or normal condition.

Results of Normal Modes of Living.

Applying these facts to orthodontia, it will be seen that some of the existing ideas concerning malocclusion are in direct conflict with these truths, which it would seem are so plain as to admit of no question. When we survey man's progress in the animal world, it is beyond question that we are not living the life to-day that man followed when the race rose to its present form. Man has changed his own environment, and has changed it rapidly. During the last twenty-five to forty centuries, man has made more change in environment than any other organism has ever experienced even through a geological age of hundreds of thousands of years. The normal life of man is far from the strenuous struggle of to-day.

The things that bring out his best development are an out-door life just active enough to insure plenty of exercise and requiring sufficient thought to promote mental development, combined with a considerable variety of food suitable for his nourishment, requiring some effort to obtain, and needing considerable preparation in the form of mastication and digestion before being ready for assimilation. These things promote to the fullest degree the development of a well-balanced man, and whenever these conditions obtain there is but little need for either physician or orthodontist. Any nation or people that follows a life of this kind shows well-developed jaws and dental arches, and well-formed, strong and regular teeth.

It hardly seems necessary to multiply instances of this fact, yet we may point out many cases. Many European countries have a large population living practically the normal life, and their development shows it. The Germans have a large percentage of people noted for fine physique;

the Poles, Bohemians, and Austrians of outdoor growth are well-developed, and irregularity among all these is uncommon. The Scandinavians are noted for their beautiful complexions and well-formed persons, and all those of country life have beautiful and regular teeth. The people of the Caucasus, the Armenians, the Georgians, the Arabs, many of the Turks, the Afghans, the Cossacks, most of the Russians, all notably lead a simple outdoor life, and all are noted for perfection of physical development, which almost invariably includes teeth of practically perfect arrangement.

Nor is the rule applicable to the white races alone. The Chinese have a large population living an outdoor life, and their jaws are ample and their teeth well arranged. It is the impression that the Chinese are a people rather under the ordinary stature, but those from the strictly agricultural districts have a large proportion of six-footers. Large size of body, however, is not necessary for proper development of the jaws and regularity of the teeth. The Japanese are a people of small stature, yet their teeth are practically regular. The nature of their country and its resources demands a simple life, and the result is a people who have astonished the world for energy, endurance, and intelligence. Most of the Malays live a healthful outdoor existence, and these are noted for courage and physical endurance. Their development is fine and attractive, including good teeth, well arranged.

The North American Indians are—or rather were—particularly noted for fine physique and regular teeth. This is true of the very early Indians as well as since the white man's coming. The author has had opportunity to examine skulls from mounds that date back many years, and they had finely developed dental arches, and good teeth that showed hard usage.

Even the inferior black races show regular teeth under their regular environment. The Kaffirs and Zulus have finely arranged teeth. The natives of Central and Eastern Africa are prized as slaves by the Arabs, and many are carried to the observation of the white man, where their good teeth are noted by all observers. Even the degenerate Hottentots and Bushmen have the jaws well-developed, and their teeth are not crowded.

The Eskimo lives under an unfavorable environment that dwarfs both his body and his mind, yet he is compelled to use his teeth much, and his jaws and dental arches are well developed. While these instances from foreign lands are given, yet it is not necessary to leave our own country for numerous examples. Wherever the population is reasonably settled in an out-door life of the normal character, the percentage of irregularity is low.

Malocclusion and Abnormal Modes of Life.

It is where the environment is abnormal that malocclusion flourishes. Nor is it to be wondered at. We struggle through life day by day—we do not quietly live, but struggle at everything. We try to do twelve hours' work in six, and the work of two days in one. We start our children to school too early, and crowd them all the time while there. In our schools and colleges we lengthen the courses, increase the requirements, and shorten the time. Boys and girls are in society at sixteen instead of in bed o' nights. The nervous system is always stimulated and never rested. Even in our play we struggle. We make a business of playing golf instead of a pastime. The baseball game is not a period of relaxation, but of keen anxiety as to whether the home club will win, or the favorite player will raise or lower the batting average. We have records to smash in everything—all must be hurry, noise, and excitement. We kill each other with dynamite crackers on the 4th of July, and yell ourselves hoarse when husky young collegians smash each other flat at the Thanksgiving football game. All nerves are kept keyed to the highest pitch—no wonder the strings occasionally snap and the beautiful human instrument gives music no more.

We are no more careful of our digestive organs than of our nerves. Our food is prepared to please the palate rather than nourish the body. It must be quickly cooked even though its value as food is lost. Lime salts and phosphates are carefully sifted out, and glucose, starch and salicylic acid carefully sifted in. Our groceries are adulterated, our meat embalmed, our butter renovated. Everything is prepared, canned, condensed. We hurry through meals and rush to work again, while the beast does better than we, for he lies down and rests while digestion progresses. We choose soft foods, and carefully set aside things that require heavy mastication. Tommy and Susie do not like crusts, so they do not eat them. It is not real nice to chew away on tough things, and decidedly impolite to gnaw a bone.

In short we over-work and over-worry, over-eat and under-sleep. We have no real rest nor relaxation, and tear down as fast or faster than we build up. The simple life is left to the "Reubens" and "Jays", but we are the real Reubens in the case. With all outdoors before us to live in and all the blue sky to cover us we crowd ourselves together in cities and live in dirt and discomfort, and shut out the sunshine with a pall of smoke. We live amid shrieks, toots, bells and yells; we dodge trolley cars and automobiles, move from flat to flat, and never know what peace and quiet means till we are in our graves, and only then because they take us out to God's own green country to sleep.

With all this is it a wonder that we are deficient in physical development, that our bones grow only enough to accommodate the light muscles that form; that food fails to nourish, that digestion is poor, that thorough mastication is not practiced, that jaws are small and dental arches crowded; that adenoids, catarrh or other hypertrophies and degeneracies are prevalent; and that more or less lack of development of all the structures of the face, jaws, mouth and teeth is the rule and not the exception?

Environment the Chief Factor in Abnormalities.

We have made a mistake in ever supposing that heredity tends to promote this abnormal condition—the tendency is all the other way. Heredity always tends to promote the normal, the healthful, not the abnormal or diseased. If a similar condition exists in parent and child, let us not jump to the conclusion that the defect is inherited, but rather let us investigate the environment. If we find contracted dental arches in the same family it is a sign that all members have lived upon the same kind of food, and all have failed to give normal exercise to the teeth and jaws. If nasal or pharyngeal hypertrophies exist from one generation to another, we will find the environment is inherited rather than the disease. We will likely find the same dry and overheated rooms, the same dust and multitudes of bacteria, the same exposure from heat to cold and cold to heat on going and coming from school, the same lack of exercise requiring deep breathing, the same general surroundings both from parents to children and from one child to another. If a certain tooth, as say a cuspid or lateral incisor, is malposed from father to son, the mechanics of eruption of the teeth should be studied instead of laying it to heredity, and it will be found that there is a general condition covering this case that applies to the entire human race.

Aside from the fact that heredity promotes the normal instead of the abnormal, it is also very questionable if a feature like malocclusion can be transmitted at all. A violent change is much less likely to be transmitted than a slight one, and a bad case of malocclusion is certainly a great change from the normal. Weismann, the great writer on heredity, gives it as his opinion after years of observation that only slight acquired conditions are ever transmitted, and scientists are very cautious as to their statements of what changes may become hereditary and what may not. Such conditions as cleft palate, club feet, or a sixth finger or toe are no greater departures from the normal than many cases of malocclusion, yet we do not expect these abnormalities to be transmitted, and they rarely if ever are.

We have been wrong not only in supposing that heredity tends to promote or transmit malocclusion, but in believing that heredity influ-

ences the development of the dental arch at all. Heredity gives us a certain number of teeth, the same as it gives us two legs and two arms, or eyes, ears, liver, stomach, etc. Heredity also influences development of these teeth in the same way and at about the same time in all individuals, and further disposes them in practically the same fashion in the jaws of all children, whether their parents are white, black or yellow. Heredity to a large extent controls the time of the loss of the deciduous set and the eruption of the permanent, but when the permanent tooth starts on its journey to its final resting-place in the dental arch it is the creature of environment from then on. The slightest thing may influence its travels; a spicula of a former tooth, a slight contraction of space, a check in general growth and development at this time, or most likely of all, a lack of ordinary use. The dental arch has a definite development of its own as well-marked as the growth of a grain of corn which has first sprout, then root; then leaves, then stalk; followed by flower and finally by the perfect fruit.

Development of the Dental Arches.

The dental arch has an enlargement equally as definite as the plant, as tooth after tooth is added, and whether this enlargement shall be perfect or not depends on whether the means Nature has provided to secure this end are employed. Each permanent tooth as it erupts travels outward from a common center that it may occupy a place in a larger arch than that needed to accommodate the temporary teeth. Its journey is not over in a few weeks nor months, but it gradually moves outward for a long time after eruption as well as some time before eruption. In fact, the enlargement of the dental arch extends from before the time of eruption of the temporary teeth until the appearance of the third molars, a period of nearly twenty years, and all the teeth are gradually moving outward and the arch attaining full size through all this time.

Nature depends on three forces to accomplish this proper development, two of which tend to force the teeth outward to the proper place, and one which tends to keep them from going too far, namely—the action of the tongue and pressure from mastication to promote outward movement, and the action of the cheeks and lips to press inward at all times and prevent the arch from spreading beyond its proper bounds. Between these forces the formation of the dental arch is balanced, and a very little sometimes decides whether it shall reach full size or not. The action of the cheeks and lips limits enlargement of the arch to less than full size unless the enlargement is forced by greater pressure outward than that exerted inward. The action of the tongue in pressing outward is possibly greater than we have credited it with—J. Sims Wallace

assigns it the power to prevent or produce nearly all irregularity—but it is easily seen that mastication must be the chief influence depended on to gain a full enlargement of the arch. This is accomplished in two ways; the lower jaw swings from side to side, and the cusps of the upper teeth interdigitating with the lower are dragged outward by this swinging motion, and each then further reacts on the other. The peculiar mechanics of the case favor an outward movement of the teeth more than an inward.

But the greatest factor in the development of the dental arches comes from the stimulation to the parts that normal use gives, and it is from this that normal growth is most promoted and finally attained. Nature intended the teeth to be used and used hard. Their function is to incise, to tear, to grind, and they normally should receive a pressure of a number of pounds in this action. Pressure upon the teeth means pressure on the peridental membrane and bony tissues of both alveolar process and maxillary bones, which pressure means proper stimulation of the nervous elements of the part to do their duty, and this in turn means blood supply, nutrition, growth. Lack of full use of the teeth means lack of these things, and the everlasting inward pressure of the lips and cheeks is not counterbalanced nor even equaled, and contraction of the arch results. Over 90 per cent of the orthodontist's cases require expansion of the arch, and over 50 per cent are entirely due to failure of this normal enlargement of the arch from lack of pressure from mastication or action of the tongue. As malocclusion from nasal and pharyngeal hypertrophies makes up fully 75 per cent of the grand total, and as nearly all of the remaining 25 per cent is due to the simplest of means, the great mystery of the causes of malocclusion shrinks from a monster to a mite.

We have been wrong on the tendency of heredity, and we have been wrong in the belief that the size of the dental arch depends upon the size of the jaws. It may seem like heresy to say it, yet the size of the jaws is influenced by the development of the dental arch rather than the reverse. There are many plain instances of this. In retrusion of the lower jaw, the bone is retarded noticeably in its development in direct proportion to the retrusion. The occlusion of the teeth steadily forces the lower jaw back through a series of years, and this results in a shortening from lack of growth. This lack of development occurs in the ramus and the posterior third of the body of the bone. If the retrusion is on one side only, the jaw is noticeably shorter on the side of the retrusion, as may be proved by measurements both upon the living subject or from skulls. If the retrusion is on both sides, development is checked in each half of the jaw; and gives rise to the well-known receding chin. The mental

eminence is developed the same as usual, and the arrest of growth is easily located in the posterior part of the bone by comparison with a normal skull.

The upper jaw is noticeably checked in its development from lack of use of the teeth, as is proved whenever the occlusion does not permit their full use with consequent pressure upon them. We invariably find with a considerably contracted arch a restricted nasal passage and more or less lack of development of all the facial bones. We also find that we may stimulate their growth to a marked degree by correcting the malocclusion and bringing about pressure upon the parts. The degree to which growth and development may be secured in cases of this kind is a physiological fact of vast importance, and which as yet we little appreciate.

While the size of the jaws is affected by the development of the dental arch in the cases cited, yet under normal conditions the growth of each is practically independent. The teeth migrate just where the mechanical forces of mastication force them, and the alveolar process follows and is built up around them wherever they may go. The writer has many skulls in which all sorts of conditions of this kind may be seen, and there is no direct relationship between the size of the jaws and the size of the dental arches. Some of the smallest bones support arches of the largest size, and the teeth therein are well arranged, showing evidences of good hard usage from their wear. The skulls of Indians, mound-builders, cannibals, white men, black men, cliff-dwellers, or Eskimos all show dental arches developed to full size, built up on jaws of widely different types and sizes, and showing an arrangement and size of arch exactly according to the use that had been given them. While the writer can only give his word for this in this paper, yet his own collection and the museums of the State University of Iowa and the Iowa Historical Society can furnish ample proof if the matter be doubted.

It is thus seen that while heredity may pass along a similar osseous framework through successive generations, it by no means follows that malocclusion travels the same path. The dental arch depends for its development on the use that the individual gives it, not on some condition of his ancestors. This statement could be verified by innumerable examples, both in the case of man and many of the lower animals, but space forbids further amplifying and those to whom this seems reasonable may accept it as correct, and others are privileged to think it yet unproved. The future will settle the matter in its own good time.

Ancestral Characters Blend.

The writer would be derelict in his duty if he did not bring up for discussion the time-honored delusion of the inheritance of small jaws and large teeth or vice versa from different ancestors, near or remote. Of all the fallacies that have been seriously discussed in orthodontia, this is the most absurd and has the least scientific foundation on which to rest. It is in direct conflict with many of Nature's best known and most widely applicable laws, and the time has come for it to be shelved along with belief in witches or infant damnation.

It is contrary to Nature's laws to directly transmit features of one ancestor without modification in some way by influence of the other. In case of two dissimilar ancestors, the resulting progeny is always a blend, showing some of the characteristics of both progenitors. This is true not only throughout the animal world, but in the vegetable world as well. A cross between a draft horse and a racer will not give an animal with the forelegs of a trotter and the hind legs of a draft animal; a blend of both ancestors will be seen. A tall father and a short mother do not have children with one long arm and one short arm, neither will one blue eye and one black eye be inherited from parents with these different characteristics. Yet these things would be the rule if the principle of small jaw and large teeth inheritance was correct. When vegetables of different characters mix, as the pumpkin and the watermelon, the resultant vine does not bear the fruit of one and the leaves of the other; the features of both are combined. In the same way any intermixture of the human race produces a progeny of blended characteristics; instance after instance may be cited, and all would prove the same point, and also prove that the idea of inheritance of the teeth of one parent and the jaw of another was an unwarranted assumption in the first place, and has only been promulgated or tolerated through common ordinary ignorance.

In closing this article it should be said that we have taken too much for granted just because somebody said it, or it was printed in a book. The book of Nature is the library to consult though the pages are not always illustrated and they contain problems to solve as well as stories to read. In this book the chapter on Heredity is written in a strange language, yet little by little it is being translated to our own. This much we know already; we have sadly misjudged this mighty force at times, and have even charged it with crimes of our own creation. Heredity is the balance-wheel of all organized existence, the friend of all life and the foe of nothing but the abnormal.

Discussion.

Dr. Varney E. Barnes, Cleveland, O. I would very gladly believe that heredity has nothing to do with malocclusion, if possible; however, I feel that the doctor has put it very well when he states that two forces are acting on every living thing, the tendency to resemble its ancestor, and the tendency to be influenced by environment. We know environment has a great deal to do with development.

Let me cite a condition which makes me think that environment has something to do with development, and also that heredity has something to do with development. If you will look at me you will notice that my arms and legs are short, but my body is long. My father had the same build. He was brought up in New England, and worked in the cotton mills, and did not get his growth as he should have got it at some other employment. I have inherited the same type of body and legs and arms, and was born in Michigan, and brought up in Ohio. My boy shows the same characteristics, and you can not convince me that heredity has not something to do with it. Environment has helped me some, as I did not have to work in the mills, and my stature is greater. My boy appears to show greater strength than my parents told me I showed. He has every opportunity to get into the open air. I believe, as the doctor has stated in his paper, that heredity seems to have a tendency to bring back normal forms. Nature does try to produce harmony. If you keep up a better environment you may get back to better conditions.

I believe that we can inherit malocclusion, but I do not believe that we will inherit malocclusion that is worse than that of our parents or ancestors. The case may be an aggravated or an acquired condition. If environment has so much to do with malocclusion why do we have this strong tendency to return to the original condition when the retainers are removed? If you can get a good occlusion of the teeth you will get a good retention.

I think the doctor has taken a rational view of the matter, and that the tendency is to re-establish the normal; however, I think that we may have both conditions at the same time.

Dr. Edward H. Angle. We all seem to have been puzzling our heads, during the past year, over this same subject—Heredity, and I fancy it was provoked by some of the "old schoolers" in their using that wise old saw for about the three-millionth time about the "child inheriting the large teeth," etc. I can't bear to go any further with it, but you all know the rest of it. Of course the few remaining members of the old school will doubtless go on

repeating it for it has been demonstrated that they are incurable. But seriously, if Dr. Brady is wrong, I am wrong, for he has written what I believe, only he has written it better than I could write it. It seems to me that it is the clearest, most logical, most sensible, most practical way of looking at the question that has ever been written. It is robbed of all those mysterious, high-sounding phrases that are so often used to hide ignorance and fraud behind in the discussion of questions, and especially of this one. I believe that what he has said is true. Every paper Dr. Brady gives us is fine, but this is, I think, exceptionally fine because it is exceptionally true, and I am proud of it.

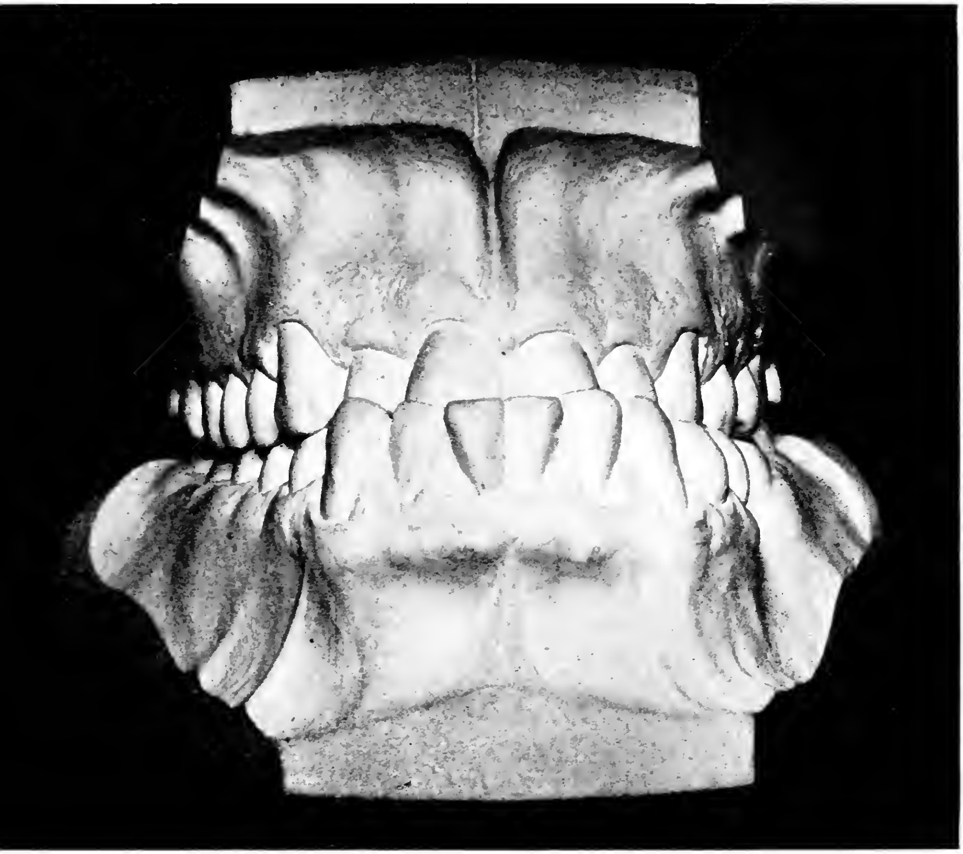
Dr. Albion G. Danforth, New York City. I have a niece now two years old, but from the time she was six months old she has shown very marked characteristics of the third class. Her father's mother has the same condition, and it appears in four of the father's family, and it has appeared in this little girl, being very strongly marked at two years. She has never been sick a day, and I do not know what would cause it.

Dr. Brady. The matter of heredity has been so thoroughly gone over in the preceding papers, and so thoroughly discussed that there is seemingly but little to say that is safe to say. I possibly did not give the exact shade of meaning in the paper that I should to indicate that the subject must be considered in a broad and general way, and that final results are what we must study and judge from. We can not depend upon a few individual examples to really see the working of heredity. Heredity always tends to return a variation to an established type, and it takes much intensification of the variation to result in something permanent.

We have in the past spoken of malocclusion as though it could be and is handed down by heredity like a wedding garment. It is nothing of the kind, and even if it were apparently handed down for one or two generations it could not thereby be counted permanent. The tendency of heredity is always back to the normal, and until malocclusion becomes so established as to be the usual or normal the action of heredity will never be to transmit it permanently. And malocclusion will never be established as the normal, for malocclusion means disuse, and Nature suppresses a disused organ. Hence if there is a constant tendency to malocclusion for untold centuries from now on, Nature will find relief by reducing the number of teeth rather than establishing an abnormal arrangement of them. This has been her remedy for such conditions since life first began, is her remedy now, and will be her remedy for all time to come.

One of the clearest statements regarding heredity I think ever made is by Orton, the zoologist, and is this: "The laws of heredity are unknown." That is certainly clear and definite, and what is more, it is the truth. We do not know heredity's laws; we know a few of their manifestations, a few simple things we are able to see and handle and measure, but the actual laws governing heredity are still mysterious as the space beyond the stars.

[Dr. Brady, in his paper, states that "neither will one blue eye and one black eye be inherited from parents with those different characteristics." A brief statement as to odd eyes in animals may be excusable. The normal white cat has either orange eyes or blue eyes, the latter preferred because of their beauty. Yet a certain prominent breeder of valuable Angora cats, has for her breeding stock a pair of white cats each of which has one blue and one orange eye. The kittens from this mating have in the majority of cases had perfect blue eyes; others perfect orange eyes, and only a few have been born with odd eyes. But even these few odd-eyed kits can not be used as evidence of an inherited abnormality, because curiously enough no other but white cats are ever born with odd eyes; and the proportion of odd eyes in this particular cat family is really less than the normal ratio for the breed, while the proportion of blue-eyed animals has been much greater than normal.—EDITOR.]



THE ABOVE IS MADE A SPECIAL FEATURE AS AN EXAMPLE OF A PERFECT ILLUSTRATION FROM A PERFECT PHOTOGRAPH, OF A PERFECT MODEL, FROM A PERFECT IMPRESSION. A SMALLER PICTURE OF THE SAME IS FIG. 7, IN DR. McKAY'S ARTICLE.

A Critical Contrast Between the Old and the New Schools in Orthodontia.

By Frederick S. McKay, D.D.S., St. Louis, Mo.

What was probably the first public reference to any such institution as a "new school" in orthodontia occurred in a paper presented before this society at its third annual meeting at Buffalo in January, 1904.

This paper dealt in a very graphic way with the conception that the majority of dentists have held of this subject, and indicated that these conceptions were passing, and that the science had emerged into a higher phase of excellence. This term "new school," as it has appeared from time to time and with increasing frequency in papers, discussions and published articles, has evidently been a "thorn in the flesh" to many men, particularly those who have been considered authorities on orthodontia.

Considering the "new school" movement as not only an advance, but also as a reform, like all other reforms, no matter how beneficent, it has been met with opposition.

As the evidence pointing to the correctness of its teaching has steadily accumulated during the past three or four years, until at present it is overwhelming, the opposition from the rank and file of our profession has steadily decreased, until there are but few who offer any strong objections.

I doubt whether at the time this name was coined it was realized what a far-reaching influence it was destined to have, or whether those who first heard it, knew that a reform had begun. Men heard the name without realizing what they listened to.

The "old school," at least to be known as such, is something which has developed since then. At that time there was no "old school." There was simply the difference between the "new school" and no "school" at all. It was the beginning of classified knowledge in orthodontia. Naturally there are those who have objected to having their time-honored theories overthrown, and these gentlemen have grouped themselves as the "old school." This is my definition of the same.

Disputed Points Settled.

Aside from objecting to the general upsetting which the "new school" teaching has brought about, there must, at the same time, be honest differences of opinion on certain points which separate the two schools. These differences are confined exclusively to orthodontists. The dental profession as a whole is neither on one side nor the other, beyond holding the merest opinions in the matter.

Such a point as early treatment of developing malocclusion has ceased to be a difference. It was one of the points, which early in the movement caused some discussion, because of its reversal of the frequent advice given before the advent of the "new school," to allow these deformities to reach full dental development before treatment.

Orthodontia has passed beyond that. The "new school" has won this point without a single dissenter.

The reform in appliances has also progressed, until the machine-made, standard, universal form is the one generally and most satisfactorily used.

Extraction.

There are, as yet, however, certain major points upon which agreement has not been reached and while for a considerable time it has seemed to be impossible to confine our opponents to real, practical, everyday cases and treatments, instead of imaginary, hypothetical cases and monstrosities, the recent issues of some of our journals at last seem to furnish us with material from which an argument can be conducted. One of the first points upon which our opponents took issue with us was in regard to the necessity of extracting teeth in the treatment of certain cases; and the dictum of the "new school" urging the abandonment of this practice, because it had found that it is no longer necessary, and because it is detrimental to the best results or even satisfactory results, was met with a storm of protest. Paper after paper has been delivered on this very point, and case after case illustrated, showing the truthfulness of

our position, until it ought not to be necessary longer to consider the subject of extraction as holding any place in a discussion on orthodontia.

In the early days, the extraction of teeth was considered a necessary part of orthodontic operations, because we had not developed the means for expansion and other tooth movement, which we have to-day. In fact, the amount of expansion and the distance that teeth can be moved safely, as illustrated by present day results, would in those days have been considered generally, as out of any range of possibility.

For these reasons, I repeat, extraction was considered necessary, and was practiced to almost any degree. It was supposed to simplify matters and was done because men knew no other way.

We all remember the time when the first molars were sacrificed; not one, but all four at times; but let me say, that such work was never upheld by either "school," but was almost invariably perpetrated by the general practitioner of dentistry who had no other guide than his own "judgment," which we now know was sadly in error in such cases. This practice, owing to the increase of our knowledge, and to the protests of the non-extractionists, has, I am glad to say, almost disappeared, but one is surprised, yes, shocked, once in a while to find that there are men, and these in our very largest centers of civilization, who still believe this method to be right.

We have also reached a point where, among men who lay any claim to any special knowledge of orthodontia, the sacrifice of the anterior teeth, above or below, is almost obsolete, and the fight has narrowed down until our defense is concentrated upon saving the bicuspids from the slaughter.

And here the situation changes. Instead of meeting our strongest opposition from those outside our ranks, we are opposed by the very men who are working in our own field, except that their alliance is with the "old school." The dental profession, I think, as a whole is glad to know that since its aim and object is to save the teeth, no matter what condition they may be in, we as orthodontists no longer find it necessary to destroy any teeth. But not so these other gentlemen. They still insist that there are cases where it is necessary to extract the bicuspids, notwithstanding the fact that the "new school" has proven over and over again and in precisely similar cases, that better results can be obtained just as easily and more easily, when the full number of teeth is allowed to remain. To those who have kept a close watch upon the literature that has been offered upon the subject of orthodontia during the past two years, and especially during the past few months, the particular instance which in the mind of the "old school" seemed to demand extraction of the bicuspid teeth one from each side on the upper jaw, is that which is

known according to the classification now generally accepted (Angle) as Division 1 of Class 2, graphically represented by Figs. 1, 2 and 3.

Our opponents take the ground that this particular condition of malocclusion is divisible into several different phases, called by such names as "full protrusions" or "retrusions," or "partial protrusions" or "retrusions" and others signifying the relationship in terms of "protrusion" or

FIG. 1.

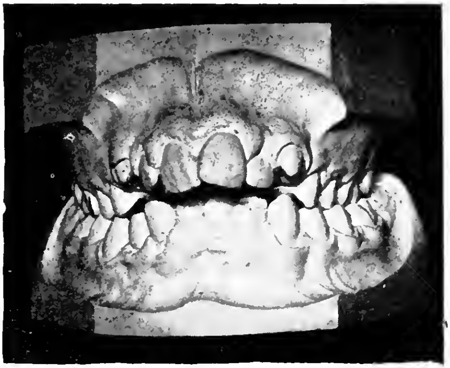


FIG. 2.

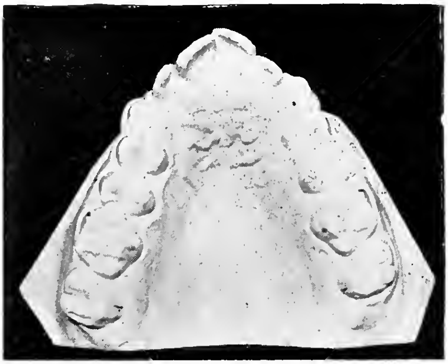


FIG. 3.

"retrusion" that one jaw may bear to the other or to the physiognomy. We are told that Fig. 4 illustrates five different phases, each presumably with its own classification. There are but five cases illustrated here, but this author's meaning is taken to be that the above is simply a sample of the almost innumerable phases that the first division of Class 2 may present. The etiology of this class of cases, the "new school" believes to be closely associated with, nay absolutely dependent upon, conditions found in the nose or naso-pharynx.

Because of the articles which have already appeared, dealing with this point, further discussion will not be entered into now. And yet the men who write along "old school" lines, for some reason deliberately ignore this factor as having any bearing upon the subject. That any such segregation as that indicated by Fig. 4 should be made in a class of cases, etiologically the same, similar as to detail and occlusion, and responding with the most gratifying results to a standard method of treatment, the "new school" emphatically denies.

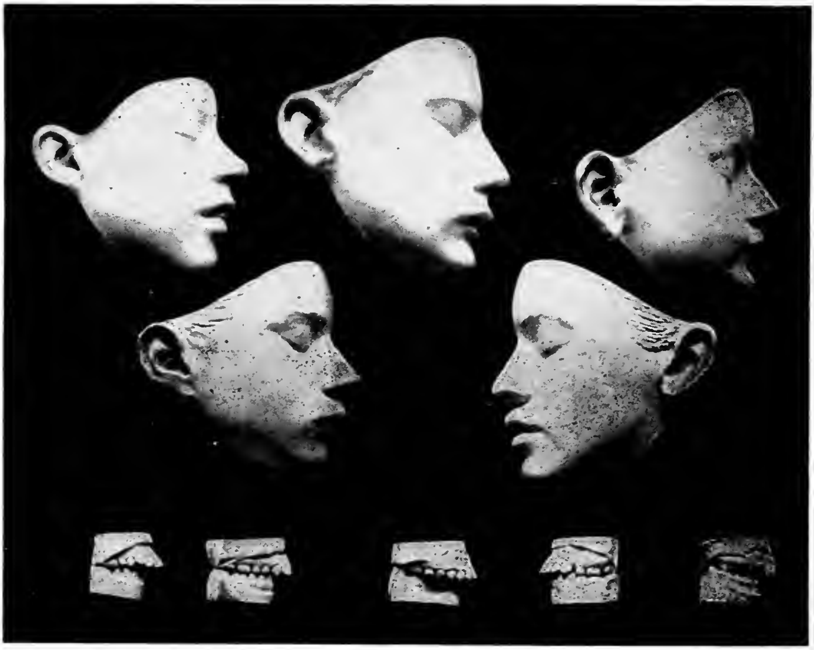


Fig. 4.

In passing, we wish to protest against such samples of photography of models as are shown in Fig. 4 because of the impossibility to gain anything like a comprehensive idea of the important features of a case. Imagine trying to study occlusal relations from such diminutive pictures of models as illustrated in Fig. 4. I trust that this author will pardon my suggesting that photography of models is a work of art, and that in justice to his readers, his illustrations should be presented in such a way as would allow the closest scrutiny from all sides, and of a size that would place the details within easy vision.

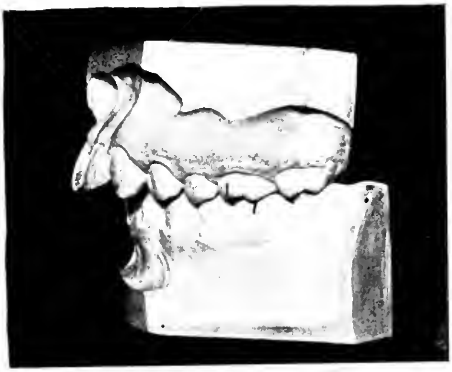


FIG. 5.

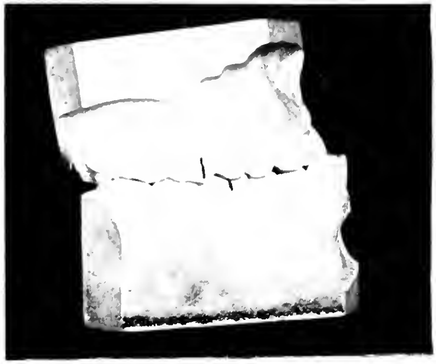


FIG. 6.

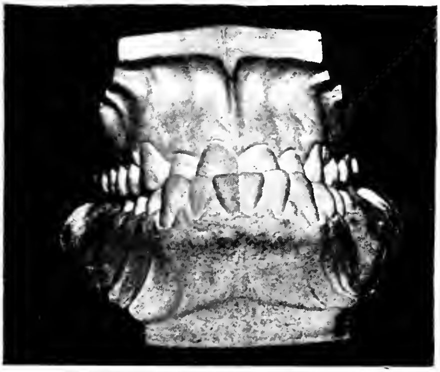


FIG. 7.

FIG. 8.

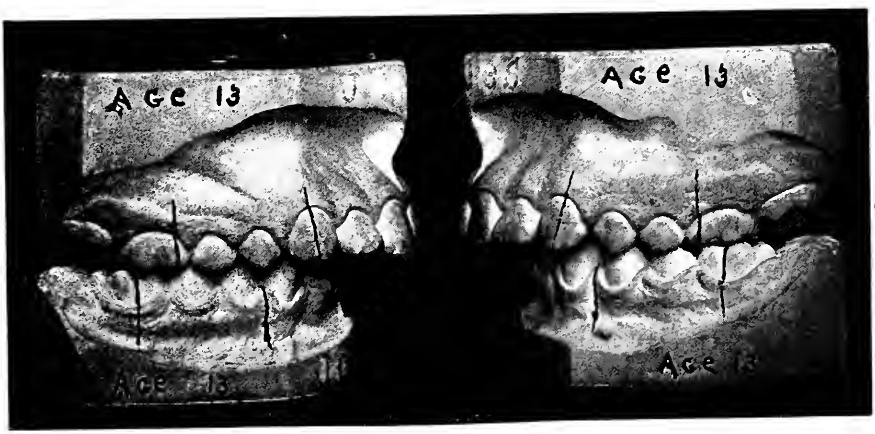


FIG. 9.

Irregularity and Malocclusion.

As to what constitutes an "irregularity" and in what way malocclusion refers to irregularity we meet with some peculiar statements, but none so peculiar as one saying that "the term malocclusion refers to only one phase of irregularity, as the teeth in normal occlusion may also be quite irregular," etc. Your essayist's conception of teeth in normal occlusion brings to view a picture showing the teeth in those positions with reference to each other, which nature intended them to occupy, and to which their anatomical shapes are best suited.

How such teeth can be "irregular" is something that is not apparent in any ordinary sense, but the author from whom I am quoting gives the term an extraordinary meaning, by implying that there is any considerable number of cases, where the overlying facial contour will be found to be inharmonious or unesthetic, when based upon a correct anatomical arrangement of the teeth.

Going a step further and considering the question of protrusion or retrusion in its true relation to art, teeth in normal occlusion will neither protrude nor retrude. Protrusion and retrusion are terms that relate to a general harmony of the face according to type or general characteristics, or the particular mold into which nature has fashioned any given face. The fleshy contour is dependent upon the underlying bony or dental tissue, and according as this tissue happens to be placed do the overlying parts adapt themselves.

In the same paragraph in which this writer tells us that in speaking of the terms "protrude" and "retrude," they should always refer to the relation which they bear to the normal dento-facial position, and not to the normal occlusal position, we find, in continuing the statement that "the disto-mesial malrelation of the teeth can in no instance be regarded as defining the character of an irregularity nor as a guide to its proper treatment." Which reduced to every-day form, means that the positions of the molar teeth for instance in the following illustrations (Figs. 5 to 9 inclusive) can not be used to determine the character of the deformity.

After evidence of this sort the question is not "How can the disto-mesial malrelation of the teeth be regarded as defining the character of an irrgularity?" but instead, "How can any one doubt it?" There seems to be an incongruity in the words of this very author himself, for he says in the same paper, agreeing with Dr. Angle, that "the first permanent molars are the true bases of their respective dental arches, the relative antero-posterior positions of which are largely influenced by the relative mesio-distal positions which these teeth assume in the jaws." This would make it appear that the question was settled and no further argument needed.

Continuing in this author's article we find this paragraph: "In a large proportion of irregularities for youths there will be found no marked dento-facial inharmony; and even those facial imperfections that are caused by a mal-relation of the teeth in occlusion will frequently disappear upon proper corrective treatment after being followed by the harmonizing influences of growth. Therefore in all these cases, however jumbled the irregularity, the rule should be *imperative* that we strive to produce a typically normal occlusion—an attainment that is impossible

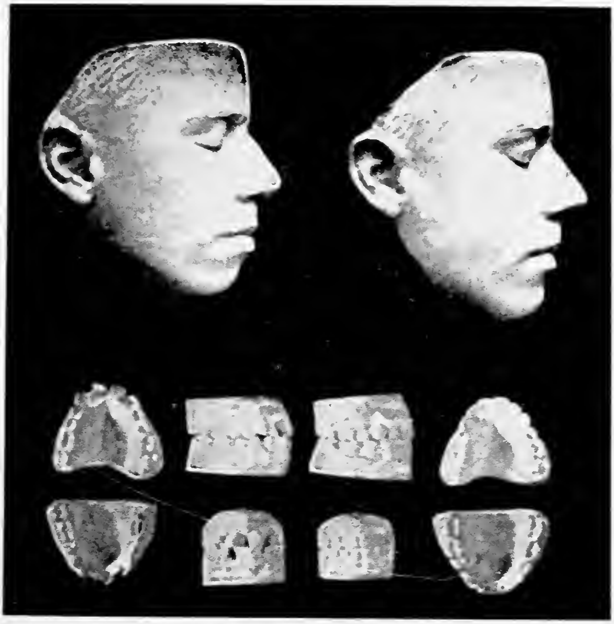


FIG. 10.

where teeth are extracted merely to simplify the operation or under the mistaken impression that regulation can not otherwise be accomplished."

One other quotation from the same authority. He says in another and earlier communication,—"with all the ordinary, crowded malpositions, it is always possible to place all of the teeth in proper arch alignment and pose; therefore that phase of the subject, that they are crowded and irregular, should never enter into the question." This is in reference to the advisability of extracting. It had almost seemed, judging from this author's published statements, as though this question of extraction had come down to but one condition which in the mind of the "old school"

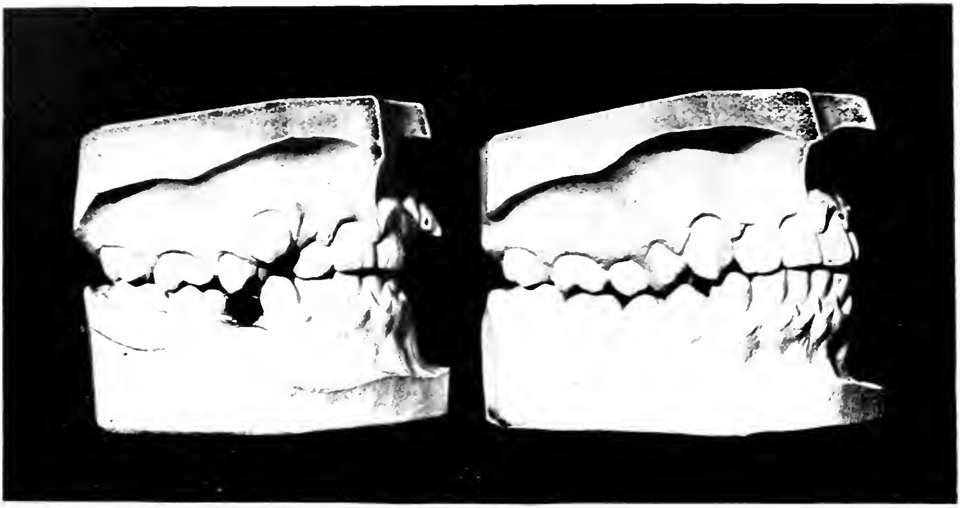


FIG. 11.

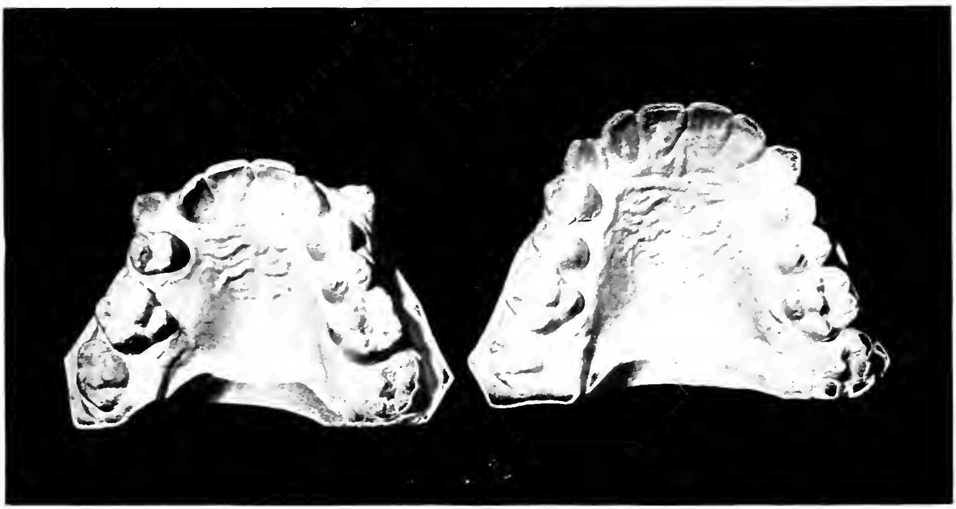


FIG. 12.

made extraction seem necessary, and that in what is known as Class 2, and so your essayist confesses to something of a shock when, in one of the latest of this gentleman's articles, the case shown in Fig. 10 was presented, and it was realized that the progress which it was hoped continued agitation had brought about, had taken a step backward.

Here is a case in Class 1 (Angle) pure and simple, the molars being

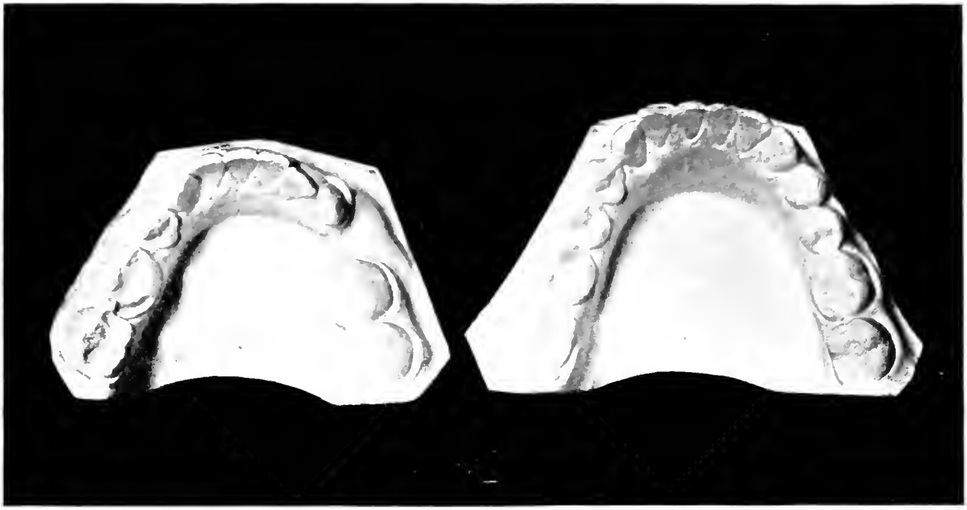


FIG. 13.

FIG. 14.

in normal mesio-distal occlusion, and like the majority of this class demanding simply expansion and rotation of the mal-posed members.

The operator tells us that the arches are "not materially contracted laterally," but if I may be pardoned for advancing a personal opinion, I should say that the arches *are* materially contracted, and will ask a close scrutiny of the occlusal aspect of the models. They are so much contracted, that the front of both arches are narrowed and the teeth forced to

take their places as best they can in such positions of displacement and torsion as is evident from the models. That the facial outline is protruding is not to be wondered at considering the torsion and labial displacement of the central incisors, and because of this it was thought to be necessary to extract the four first bicuspids. It was not because he thought that the alignment could not be accomplished in any other way, for only a few lines back we were told that "in all the ordinary crowded malpositions (and the "new school" fails to see where this case is anything different from an "ordinary crowded malposition") it is always

Fig. 15.

possible to place all of the teeth in proper arch alignment and pose, consequently extraction should never enter into the question." What was the reason then? It was because the operator feared, nay, he was satisfied, that alignment without extraction would result in an enhancement of the already protruding facial outlines.

Upon such an operation as this, the "new school" opposes radically the plan just set forth, and under no circumstances would one of its members practice such a mutilation. Were the fear of producing an intensified facial protrusion through treatment without extraction anything more than imaginary, then caution were wise, but there is in the hands of the "new school" members an immense amount of evidence, in the form of finished results, that proves that conservative treatment even in cases more severe and pronounced than this, does not produce an inharmonious facial protrusion.

One of the most remarkable cases of enlargement of the alveolar process for the accommodation of all the teeth of both arches, which has ever been published, is from the practice of Dr. Pullen. I reproduce it here together with the profile of the patient after the expiration of treatment (Figs. 11 to 15), and it is distinctly evident at least to my mind that the facial outline is not protruded beyond a degree compatible with the physiognomy of this particular individual.

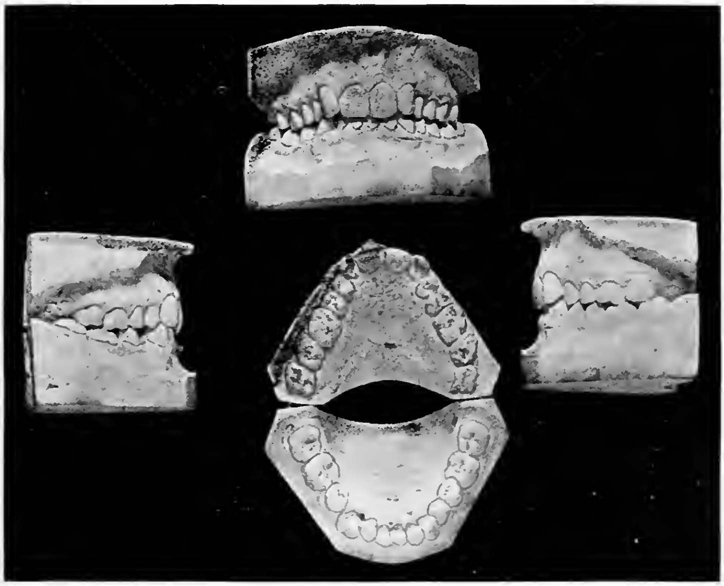


Fig. 16.

Figs. 16, 17 and 18 are from the practice of Dr. Weeks and illustrate exactly the same point. A daring amount of expansion has placed the teeth in alignment and normal occlusion, and yet the face has not been protruded as a result.

Because of having the illustrations of these two cases at hand, I have taken the liberty of reproducing them, showing as they do exactly the point we are arguing. They are taken as typical of results of treatment of this particular class of cases, and I am sure they could be duplicated many times over in the work of many of the members of this society.

Looking again at Fig. 10 let us suppose that in the early or formative period of this deformity the patient had come under the care of an

orthodontist, and as fast as these tendencies to mal-eruption had become apparent, the arches had been enlarged.

No intelligent practitioner, and surely no one who essayed the practice of orthodontia, would even have thought of any extraction, but would have proceeded along the line of enlargement and the result would have been that the teeth would all be in the mouth and in their normal positions. Probably at the commencement there was little or no "dento-facial inharmony," but had there been any, it would have disappeared upon

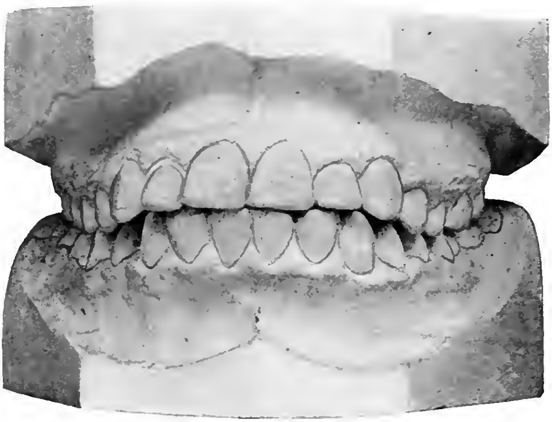


FIG. 17.

proper correction, and at the present time under the influence of growth, and with all the teeth in place, we would have found the face to be just as Nature had intended it to be, barring, of course, other influences. And the gentleman who contributes this case believes that, because he has said as much. Hear again his words on this point: "In a large proportion of irregularities for youths, there will be found no marked dento-facial inharmony; and even these facial imperfections that are caused by a malrelation of the teeth in occlusion, will frequently disappear upon proper corrective treatment after being followed by the harmonizing influences of growth." From which I again state, that had the teeth early been placed in normal occlusion, we have every reason to believe that the face would have completed its full growth, and the area about the mouth would have been found to be in harmony or esthetic dento-facial relation.

Very well then, if the restoration of normal occlusion at this early age would have been productive of such beneficial results, and would therefore have been considered as the ideal treatment, why not at the age at which this case presented? At the present age the processes of growth

and repair have by no means finished their work, and the period has not yet passed when growth of alveolar process and superimposed tissue would take on its activity again and complete the development to a point where the best harmony between teeth and face would be established.

This face just as we first find it, is as it is, because the teeth are as they are. It would be absurd to premise that the face was inharmonized by Nature as an indication to the odontocide that he must disarrange her plan and mutilate her work; that the teeth were purposely disarranged to intensify the already inharmonious setting and make it

Fig. 18.

well nigh impossible for one to pass by and not see that the face was all wrong. Nature can not go back on her own work or her own plan. The fact that a certain number of normal teeth (not supernumeraries) were placed in the mouth, means just one thing,—that there is only one position in that mouth where they belong or ought to be, and that one position is in normal anatomical relation with their fellows, and when they are so placed, the facial outlines about the mouth must be correct for that particular individual.

Nature prefers that they should be in this position, because she invariably puts them there when her plans are not interfered with, and has followed this plan of placement since man has had teeth. Does it not

therefore seem presumptuous to try to alter so long and well-established a precedent? The "new school" to a man believes extraction in such cases to be unwarranted because unnecessary, and deplores this instance

FIG. 19. FIG. 20. FIG. 21.

of it, especially from one who is skillful enough to have accomplished the treatment without it.

Judging from the particular kind of an illustration this author uses to portray the profile of the face, the artistic merit of the result might

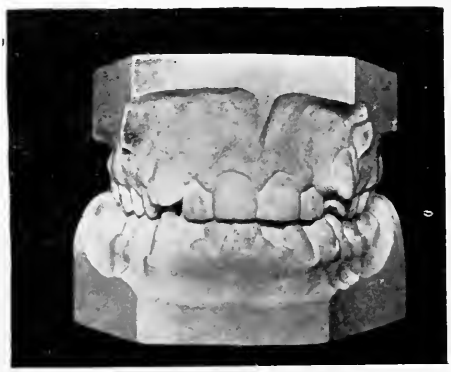


FIG. 22.

be debated. Our contention is that from a critical standpoint of facial art, the result would have been better by leaving the teeth all in place.

The two cases last illustrated (Figs. 11 to 18) are meant to refute the fallacy so often indulged in by this author, that the restoration of normal occlusion is at the expense of producing a facial deformity. That

fear has long held a place in the mind of the amateur in orthodontia, but those who have given the matter the greatest number of trials have found that it does not work out that way, and if there are any such cases they would be very interesting, especially to the members of the "new school." They have not been presented in evidence as yet.

Inheritance.

When a discussion on orthodontia is directed toward that class of cases in which the first molars are found to be in normal mesio-distal relation with

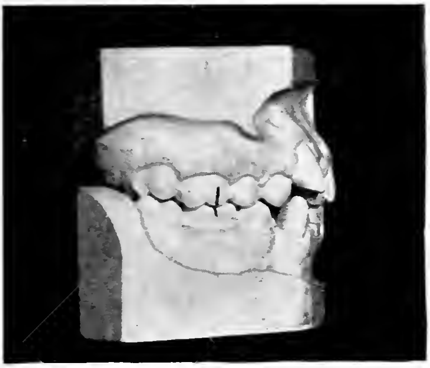


Fig. 23.

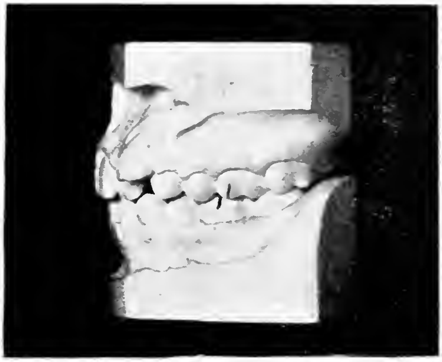


Fig. 24.

Fig. 25.

Fig. 26.

each other, illustrated by Figs. 19 to 26, which is a fairly typical case, the idea that any of these teeth occupy the positions in which we find them because of inheritance, is one rarely if ever considered at the present day because it is plain that the results, as we see them, are due to local causes.

The teeth in this instance were intended to occupy as perfect positions as those in Fig. 27, but they did not. Just why, we do not know,

but some thing, or several things, have gone wrong somewhere in the plan. It has been stated many times that the reason was because the first permanent molars had moved forward, owing to the premature loss of the temporary molars. To infer that this is responsible, is not justified.

The trouble is not that the molar region is too far forward in relation to the contiguous anatomy, but that the cuspid region is contracted and the incisal region suppressed. A further glance at the face in Figs. 20 and 21 will show that a full restoration of the fronts of the arches is needed to complete the contour of the face. From a study of this class of cases, it seems logical to assume, that when the first molars are found to be in normal mesio-distal occlusion, they are in their correct positions

Fig. 27.

in the anatomy, and inasmuch as Angle writes that in almost seven hundred cases in a thousand, the first molars are normal, it would follow that if these teeth are not in normal occlusion, the proper treatment is to place them so. When we come to those conditions sometimes spoken of as upper or lower protrusions, such as are illustrated by Figs. 5 and 7, the idea that inheritance is to blame is something that the "new school" emphatically disbelieves, and as in Class I before referred to, considers local causes blameworthy.

That inheritance should decree that the first molars should erupt in abnormal positions is not in accord with common sense, nor with what actually occurs in the mouth, nor with the principles of evolution. If one

could only watch the process of displacement from its beginning he would see that there certainly was a time even to a particular day or hour, when the distal position, for instance, of a lower molar or both of them started. There was a time when these teeth rode on the summits of the occluding cusps, and some particular influence, not heredity, determined whether they should slide one way or the other, and that way they moved. Supposing at this particular time or we will say soon after, the orthodontist had seen what was going on, and knowing what this change meant, had applied force to place these straying members back where they belonged, and had been vigilant in his watch to see that they stayed there, what

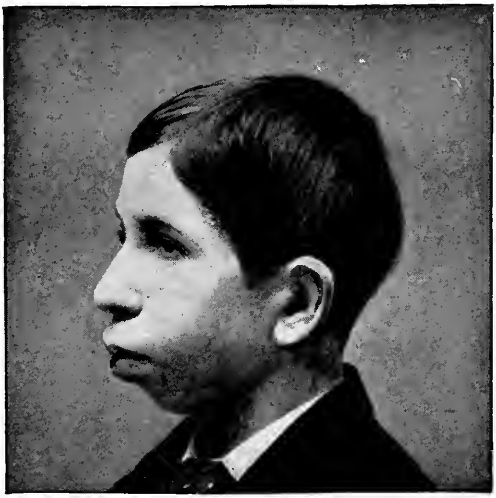


Fig. 28.

would then become of the theory that heredity had issued a decree?

The same thing exactly holds good of Class III or lower protrusions. A gross injustice has been done the "new school" by assuming that our unvarying practice in correcting mesio-distal malocclusions is the "unrestricted use of the intermaxillary force," to protrude the teeth of one arch half their diameter, and retrude their antagonists an equal distance. Such is not the case. There are, to be sure, times when just this is required, and there are also times when something quite different is demanded. I beg to assure this gentleman that the "new school" is not so hopelessly committed to a mechanical hard and fast rule of treatment, that all esthetic requirements are overlooked. While it is considered that in restoring a normal occlusion, we have done the very best for the

patient esthetically as well as otherwise, it is found that sometimes the whole movement, or the greater part of it, is performed on one jaw alone, according to the best art requirements, and the "new school" would be disappointed, to say the least, in any of its members who would overlook so important a point.

One of the most astounding statements concerning the relation which a normal occlusion and dento-facial inharmonies bear to each other, is found in a paragraph from the same author whose views I have been discussing. He states that "dento-facial inharmonies, not uncommonly to the extent of decided facial deformities, quite as frequently and extensively exist between the positions, sizes and relations of the teeth in normal occlusion, and the physiognomy of the individuals in which they

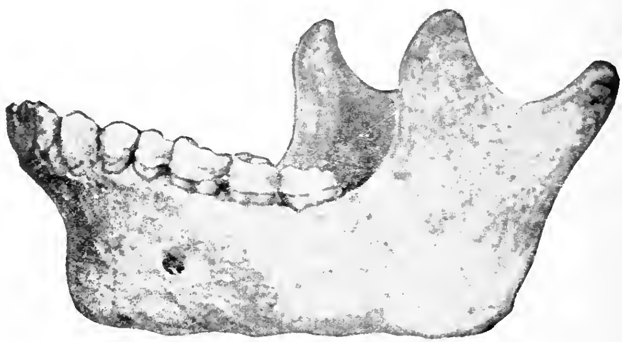


Fig. 29.

are placed, as between any of the other organs,—the eyes, the ears, the noses and the physiognomies of which through the laws of heredity they form a part." Which means, stated in fewer words, that dento-facial inharmonies severe enough to be considered as decided facial deformities, may exist in a face overlying a normal occlusion. If a case like that could only be published so that we could see it, we could better debate the question.

I can not resist the duty which at this time seems to fall to me in a discussion of this nature, and attempt to set right many who might be misled by a statement which has appeared a number of times in print among the writings of one prominent as a teacher and through his research work, which seems to be at least a misinterpretation of one of the facts dealing with occlusion as a guide in orthodontia. The gentleman says that he can not agree with the assertion that "if the first molars or premolars be properly locked, the other teeth will be in good occlusion." Let me say for his comfort that he nor any one else, is not ex-

pected to agree with any such statement, principally because it is not true, and secondarily because no such statement ever emanated from the "new school."

Figs. 22 to 26 will serve again to illustrate that it does not follow, because the first molars are normal, that the other teeth will be also. We see a most decided malocclusion anterior to the cuspids. When, however, the molars are normal, the rest of the teeth have a *chance* to assume the normal which unfortunately does not always occur.

Bimaxillary Protrusions and Retrusions.

When a student it was my privilege to sit under the instruction of this teacher and I remember distinctly his lecture describing the case next shown (Fig. 28) and the lecturer stated that the gums and alveolar process were in a most marked condition of hypertrophy. Does it seem strange then that the lips are protruded ex-

Fig. 30.

cessively? Here is a condition in pathology, and, of course, corrective measures would of needs be something out of the ordinary or out of the realm of pure orthodontia. It is of course to be regretted that the condition of this case forbade the possibility of securing impressions before the operation so that the positions of the teeth could have been determined and possibly some idea gained as to just how much the occlusion was responsible for this protrusion. In the absence however of such models the evidence to prove that we would be justified in considering that this boy's lower jaw looked like Fig. 29 or that his occlusion was like that in Fig. 30 is lacking.

To take up the question referring to so-called "full (bimaxillary) protrusions and retrusions," and considering that Fig. 31 is meant to illustrate the same, I take the author's meaning to be that the teeth in each of these photographs are in normal occlusion. Let me quote: "Full

(bimaxillary) protrusions and retrusions are probably given no place among irregularities of the teeth by the new school, because the teeth being already in normal occlusion, they claim this position is 'incompatible with any degree of irregularity' and consequently the facial outlines which appear to us to be decidedly deformed must be correct, as 'normal occlusion and normal facial lines are inseparable.' "

"Normal facial lines" is a term that is exceedingly difficult to define or describe. I doubt much if there is any universal standard applicable to all alike; but *harmonious* facial lines, that is to say, harmonious to the

Fig. 31.

frame of the particular individual, is quite another matter. The time has been when orthodontists thought there was one standard pattern to work towards, and that there were lines and measurements to trim to, but this plan failed, or at least was impractical. We no longer try to fashion every face to that of Apollo Belvidere, the Greek type. To discuss this phase would lead us just now to too great a length. But if I have understood this author correctly, and if the teeth in these three faces are in normal occlusion, then if "old school" methods would extract teeth from such arches to alter any "irregularity," so-called, it seems to me that the less that is said about malpractice in referring to any methods which the "new school" may have the better.

In the publication of Fig. 32, which is taken from the July, 1905, Items of Interest, the author of the article has been one of the first to publish a condition which has been rarely observed. I refer to the temporary denture in distal occlusion, before the eruption of the first per-

manent molars. That any considerable proportion of the multitude of cases in distal occlusion can be traced to an inherited malocclusion of similar nature having "stamped itself upon the deciduous teeth" is rendered out of the question by the disproportion between such cases. If

Fig. 32.

this condition were really inherited, and hence had to be so, I would suggest that abortive attempts to place the first molars in normal occlusion be dispensed with and that the case be allowed to progress to its full develop-

Fig. 33.

ment, so that a bicuspid from each side could be extracted to reduce the protrusion. Otherwise the child might grow up to have a partial protrusion above and a partial retrusion below or something equally absurd.

Fig. 34.

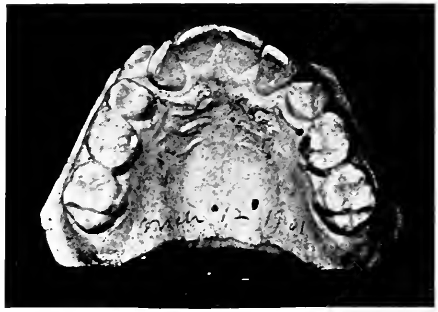


Fig. 35.

Fig. 36.

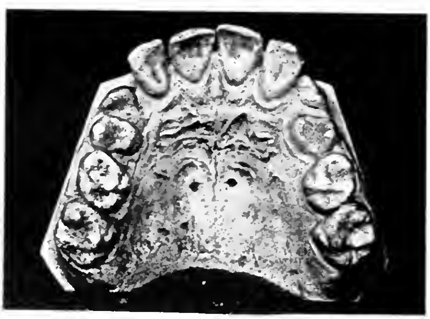


Fig. 37.

Fig. 38.

This I take to be a sample of "old school" reasoning. One of these same gentlemen whom we have been discussing objects that he "has seen patients directly from orthodontists having just such an arrangement of

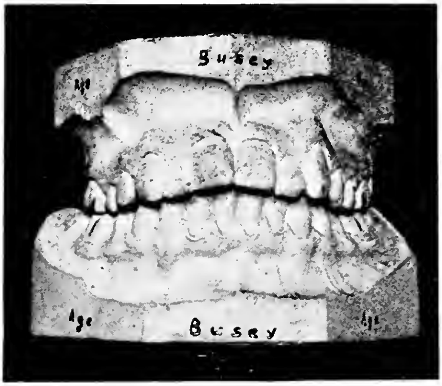


Fig. 39.

Fig. 40.

the teeth as in Fig. 33 otherwise known as 'Old Glory.'" The Lord be praised! Would that he could see more of them! And they were "prognathous-looking." Horror of horrors! No doubt they were at the time at which he saw them. I do not know what this gentleman would

have thought if he had seen the next case to be shown (Figs. 34 to 40) at the time she came from the orthodontist. He would have noticed some prognathism here also, and judging from Fig. 36 a little of that was what she needed. Any appearance of prognathism is certainly not apparent in Fig. 40 after a treatment by excessive expansion (from the practice of Dr. Angle) and after an equal lapse of time I venture to suggest that if the gentleman who objected will again look at the case he saw, he will find little prognathism there, provided such essentials as normal occlusion have been well looked to. Few are the cases that have reached final results as they come from the orthodontist.

From plaster cast, showing malocclusion of the teeth.

Profile view of face of person from whom the cast was taken.

Fig. 41.

Because of the ardor with which the "new school" men combat the idea of extraction and because, also, of other ideas which they hold, such, for instance, as advocating the distal movement of molars when necessary to restore normal occlusion, they have been termed "extremists" which might indicate that the conservative men are all to be found among our antagonists. What do you suppose then one of the "conservatives" high in the profession did to this poor unfortunate girl shown in Fig. 41? So "radical" is this "new school" that he dare not let an attempt be made to restore this mouth to as near normal as possible, sacrificing the full ideal if necessary as it sometimes has to be in such cases. No! "Conservative" treatment was called for here, and so the upper anterior teeth were removed, the alveolar process cut away with the surgical engine, and an artificial substitute for the missing teeth and process put in place. My contention is that the "new school" should at least have had a trial with this case, and if failure had been the result, then there would still have been ample time for mutilation such as the above.

What is interpreted as an attempt to bolster up a forlorn hope considering the strength of the present day movement, is the dangerous play on the word "judicious" as applied to extraction. Dangerous, because it tends to perpetuate the idea of many who have not kept in intimate touch

Fig. 42.

Fig. 43.

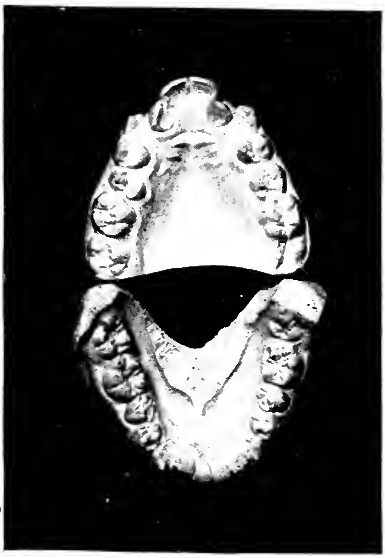


Fig. 44.

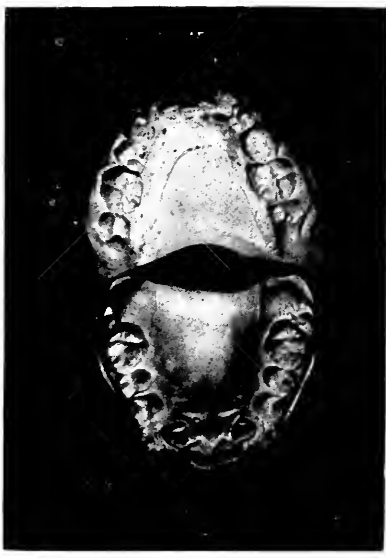


Fig. 45.

with the progress of orthodontia, that cases are common calling for judicious extraction.

In studying another one of the "old school" writers recently, one who uses this term "judicious" frequently, I find some peculiar arguments.

Among these is one which makes the mode of treatment to be followed, subject to a parent's judgment. Imagine a surgeon asking a parent how the child's fractured arm should be set, or as to just how the parent wished the appendix removed? Parents frequently come asking that some tooth be extracted to allow crowded teeth more room, because they do not know it can be done any other way, but my experience has been that when they hear that such practice is now behind the times, and that there is no longer necessity for it, the information usually comes as a happy surprise. And again to be told that the child of wealthy parents should be

FIG. 46.

FIG. 47.

put through a more severe operation than the child less fortunate financially, and should have the torture dished out in more generous doses because better able to pay for it, carries a point that is not at all clear. The author whose views are thus outlined expresses himself in these words:

The Wishes of Parents.

"In many instances, where the parents are cultured and have the esthetic feeling strongly developed, they will desire to have all deformities of their children's mouths corrected in the most perfect manner possible. They are willing that any amount of time shall be taken, discomfort endured, and expense incurred, only asking in return that the results shall be as artistic, esthetic and beneficial as our skill can make them.

"On the other hand, there are those who desire only to have any glaring deformity corrected, allowing minor defects to remain as they are. Their wishes in regard to this matter may be prompted by the physical condition of the child; by a desire to limit the expense of the operation, or by a feeling that a fair amount of improvement in the condition will answer all necessary purposes.

"What shall we do in these two widely varying classes of cases?

"Shall we insist upon treating each in the same manner?

"In regard to the first class there will be no difficulty. The parent desires a result approaching the ideal, regardless of other considerations, and we are only too glad to put forth our best efforts and bring to the work the best skill of which we are capable.

FIG. 48.

FIG. 49.

"In the vast majority of such cases, extraction will not be necessary, for with time at our command and the appreciative assistance of the parent, we will usually be able to bring about results nearly ideal.

"But how about the other class?

"Shall we insist, in spite of the wishes of the parent in regard to the limitation of the work, that we must pursue the same elaborate course of treatment as in the first instance? Certainly not."

Supposing that the operator knows no better than to allow himself to be drawn into error by an argument of this sort, and yielding to it, resorts to extraction, with the idea that the operation is to be simplified, either as to physical endurance or labor spent.

Figs. 42 to 49 are used to illustrate this writer's paper, introduced as cases to bear out the above arguments. Considering first Figs. 42 and 43 the text says as follows: "There is labial misplacement of the upper

right cuspid with insufficient room in the arch for its accommodation. By rotating the right bicuspids and moving them slightly backward, space was obtained and the cuspid brought into line. As there was no upper protrusion and the overbite was natural it was decided to extract the upper left first bicuspid. This was done and the malposed lateral and cuspid brought into position. The lower arch was normal in size and outline and therefore did not call for any change. To have corrected the irregularity above, preserving all of the teeth, it would have been necessary to enlarge the upper arch, thus producing great inharmony between the two arches, accompanied by anterior protrusion of the upper one. Would not this have been producing a greater deformity in the correction of a lesser one?"

Fig. 50.

In regard to Figs. 44 and 45 the text says this: "In the upper arch of the boy (Fig. 44) the two first bicuspids were extracted and the teeth aligned in the usual way. The girl's upper arch (Fig. 45) was expanded by means of the expansion arch and wire ligatures until a harmonious line was obtained. The girl's lower arch needed only a little expansion to rearrange the anterior teeth, but even with this it was found that the upper arch was unnaturally large and prominent. Both parents and operator were dissatisfied with this result and as a consequence, the upper first bicuspids were removed and the arch again reduced in size to harmonize with the lower."

Figs. 46 and 47 are views of the occlusal aspect of the models showing the conditions as they now are and Figs. 48 and 49 show the occlusion as it now is.

The "new school" immediately recognizes Figs. 42 and 43 as a case in Class 2, second division (Angle) which means that it is typical of a certain definite condition of things, due to certain definite causes, demanding a certain definite treatment, and therefore entitled to a certain definite name. The author who presented it had no name for it, which I might remark in passing illustrates one of the differences between the "old" and the "new schools." Knowing how this same operator has on previous occasions expressed himself relative to undertaking the distal movement of molars, it is presumed at this time that one of his reasons for treating the case as he did was because he did not wish to undertake to move the upper molars distally, which was what the case properly demanded. This must be interpreted as meaning that he did not recognize that the malocclusion of the molars was responsible and the cause for the conditions in the front of the mouth as he found them. In other words the case was treated without a diagnosis. That my premise is correct is borne out by another statement which he makes in the same paper, in describing another case (Fig. 50) in these words: "The superior laterals, probably due to late eruption, were forced by the incoming cuspids to overlay the centrals and become turned upon their axes. The cuspids therefore were anterior to their proper position and in consequence the bicuspids and molars occupied advanced positions. As the lower teeth were normal in outline and arrangement it was deemed inexpedient to enlarge the upper arch, so the first bicuspids above were removed and the laterals and cuspids moved into place."

There is a sample of "old school" diagnosis! Not one word about occlusal relations, nor facial lines, and the whole proposition just rear end foremost. Contrast that if you please with how the "new school" would diagnose the same case: The lower molars having assumed a position distally in relation to the uppers the entire lower arch was carried into retrusion. Owing to normal lip function the front of the upper arch was forced back in an attempt to occlude with the lower and naturally the upper incisors were forced into malalignment and torsion.

To straighten out the tangle would require that the molars be restored to their normal relations and the arches harmonized with each other by placing the occlusal planes normally.

This author's justification for his method was that it made just the difference between a simple operation and an elaborate one; that the physical endurance on the part of the child might be equal to his method and not to the other; that it was one of those cases in which the parent wished only to have any "glaring deformity" corrected, and to allow the "minor defects" to remain as they are; and that extraction would so simplify the operation that a small fee could be demanded as against the

more elaborate operation and thus, it might be, place the case within easier financial possibility for the parent.

I venture the assertion that there is not a man within the sound of my voice, who if left entirely to his own option would not prefer, yes, insist, that he be allowed to do this same case according to the dictates of normal occlusion, and would guarantee that it would be done with a less amount of labor to himself, and with no more physical inconvenience to the patient. As to the fee, this question would never enter into the mind of the "new school" man. He would do it in exactly the same way whether he received fifty or one thousand dollars. If there is a right way to do an operation for the wealthy child, there is no other way to do it for any one else.

While we can not tell from the illustrations which division they belong in, it is evident that Figs. 48 and 49 were cases in Class 2, the lower being distal. In order to contrast the two methods side by side, the operator decided to extract in Fig. 44 and expand in Fig. 45. We have heard how he pronounced the plan of expansion a failure. Now why was it a failure? In the first place it is plain again that there was no attempt at diagnosis. If there had been it would have been evident that to leave the upper arch the width of a cusp in advance of the lower, and then expand the teeth into alignment could have had no other result than to create an unnatural protrusion, because it would simply convert the case into one in Division I. This patient we are told is still wearing retainers. A glance at the way the occlusion has been left, without an attempt even at interdigitation, will satisfy one that it is well she is, and unless conditions right themselves to a considerable degree, a retaining device might well be considered as a permanent necessity.

The same aversion to undertaking a distal movement of the molars that this gentleman has previously displayed is again apparent, and for what reason it is not easy to understand, unless it be because he is among those who object to the "unrestricted" use of the intermaxillary force. Whatever controversy may exist regarding the introduction of this method of applying force, it is a certain fact that no other appliance in use to-day, will accomplish changes mesio-distally so easily, quickly and satisfactorily as the intermaxillary elastics.

The question of extraction it is hoped will some day, and that soon, be laid to rest, and when that great day comes, the "new school" will feel that one of the principal objects of existence will have been achieved. Only those who know can have any idea of the disappointment this body feels, in realizing that instead of encouraging it in this work, criticisms and objections are thrown into its pathway by those who should be in the utmost accord in this great work of redeeming orthodontia. Ap-

parently now the only point that separates the "old" from the "new" in doctrine, is this matter dealing with the necessity for extraction in some cases, and this one difference rests upon a principle which seems to be a fundamental one to each side. Briefly stated, it is whether we shall accept normal occlusion as the guide to facial harmony, or "dento-facial harmony" alone, allowing any changes to be made in the number or positions of the teeth, which in the operator's judgment would improve the facial lines. And in the term "operator's judgment" I have spoken the essence of the whole situation. Dento-facial harmony" is only another name for individual interpretation, and this as a guide is too vague and unreliable to be of any practical value. To substitute it for so definite, comprehensible and attainable a principle as the normal occlusion of the teeth as a guide and standard, would be a deplorable retrogression, and would lead us straight back into the very condition from which we have emerged. This standard "individual interpretation" is none other than the one that men built upon years before, when they knew not what relations normal occlusion bore to the facial lines, and there are few in the realm of orthodontia to-day, who do not feel the blush of shame in their cheeks at the results obtained under such a system. Under such a plan there is absolutely no restraint. An operator can interpret a given case as he sees fit and his results, be they what they may, would be justified, because he followed his conception of what "dento-facial harmony" should comprise.

However accurately one man may be able to apply this guide in his own practice and satisfy himself as to what "dento-facial harmony" really is in each given case. I am positive that but a trifling proportion of those who would undertake orthodontia, are in possession of so rare and exquisitely delicate an appreciation of artistic principles, as to enable them to successfully apply such a principle. On the other hand, taking the normal occlusion of the teeth as a guide, and believing as we do that when the teeth are so placed we have done the very best possible that can be done for that face in so far as the teeth are factors, we are furnished at the outset with a guide that admits of no individual interpretation, with its possibility of error, and is furthermore within easy comprehension.

Any reform has, preceding it, conditions that were abhorrent to the victims of those times, and the two greatest blessinsg that this reform in orthodontia has brought have been "system" and "simplicity."

I can do no better in my last words than to repeat those used so often by the founder of this society: "In art, in all things, the supreme excellence is simplicity."

Discussion.

Dr. Milton T. Watson, Detroit, Mich.

In regard to this much discussed subject of extraction let me say that any criticism I have to offer is not intended to reflect upon men who resorted to this practice in years gone by, for at that time no better way was known; but I confess I am at a loss to understand how any man can defend it as a *practice* to-day. In my home city, I am glad to say, we have little to fear along this line, because the better men there have come to see the folly and unwisdom of such a course. Among the men who have attained more or less national prominence, we are able to count on the fingers of one hand all who are still vigorous in the defense of this practice, and even among these the need for extraction, from their point of view, is growing less. We are all reasonable enough, I think, to admit that there may be cases which may be characterized as unusual freaks of nature, where better results, from an esthetic standpoint, may be obtained by the extraction of one or more teeth. The number of teeth to be extracted in such a case is a matter of personal opinion, a point upon which we may honestly differ, so that we can hardly hope for a unanimous verdict. In the treatment of all the characteristic types of malocclusion, presenting the usual conditions, I think there are not above three men of prominence in orthodontia who consider extracting necessary, or even permissible. Almost a unanimous verdict, is it not? I can see one potent reason why men may differ in their judgment as to the need for extracting which is simply this: a man treating according to a certain plan might consider extraction necessary, while in the hands of another man with a plan of treatment whereby any or all of the molars might be carried distally, extraction would not seem at all necessary. The individual skill of the operator is an ever-present factor. The argument is sometimes put forth that it is necessary because of financial or other reasons to adopt some short cut, but this can in no way affect the fundamental principles, and hence has no place in such a discussion.

To illustrate: Suppose a child fifteen years old should be brought to you from a country hamlet—where treatment could not be secured—who presented a case of the Subdivision of the Second Division of Class II, with the cuspid crowded outside of the arch but all the other teeth symmetrically arranged in a small dental arch. The question for you to decide is, would you rather have the child go through life with the cuspid in that condition or extract the bicuspid and let the cuspid come down of its own accord? Suppose you decide in favor of the latter, is that an argument in favor of extraction rather than expansion and the retention of all the teeth? Not at all. There is a right way, and a mere emerg-

ency which caused you to digress should not establish a precedent by which you will be guided in future cases.

In order that we may do our full share toward removing any barrier from the path of science or art, let me suggest that the term, "New School," be used less frequently and offensively, and the more modest expression, "Modern orthodontia," be used in its stead, for that will offend no one, but will include every one of high and honest ambitions. We must not forget that the knowledge possessed to-day has come to us in a large measure because of the accumulated evidence resulting from other modes of practice. The principal influence which brought this society into being was a desire to teach and preach the truth, and to do good to humanity, and if there are any expressions, any little peculiarities of speech, employed by us which grate upon the sensibilities of any one, let us be generous and courteous.

I am going to make one criticism of Dr. McKay. He has committed the grievous error of saying what some "old school man," as he is pleased to call him, would do with a case which he has shown us. Let us not convict a man until the crime is committed. The Doctor falls into the same error that the gentleman whom he criticised fell into when he assumed that we would treat all cases of the second class alike.

Dr. G. P. Mendell, Minneapolis, Minn.

I heartily endorse Dr. McKay's paper, but Dr. Watson's suggestion that we call ourselves something other than the "New School," to make us less offensive, does not seem to me well taken. The offense seems to be because we have separated ourselves from the other school, but that, of course, we are obliged to do because we do not believe what they believe and they do not believe what we believe.

Dr. R. B. Stanley, New York.

The terms "New School" and "Old School" have given rise to many discussions, and even bitter feelings, since they have come into use. Whether there is or is not a New School or an Old School it is clearly evident to those who studiously follow the many articles published in the dental journals that there exist two widely different standards from which the basis of treatment is determined. On the one hand it is held that normal occlusion of the teeth is incompatible with any degree of irregularity and is the accompaniment of harmonious facial lines: a doctrine which places the treatment of malocclusion upon a definite basis. Contrary to this it is asserted that the occlusion can be normal and yet have an irregularity, or be accompanied by inharmonious facial lines: a doctrine which does not place the treatment of malocclusion upon any definite basis, but leaves it to the individual to determine in any given case whether the Lord intended this one of his creatures to have a full

complement of teeth and yet possess the composite facial lines inherited from the various types of his ancestors. Note, that the difference between these two teachings lies not in the assertion that teeth can or can not be placed in anatomically correct positions, but in the conception of what constitutes harmonious facial lines.

To be strictly impartial to both sides of the question it is absolutely necessary to deal with actual clinical experiences. To state a hypothetical case, or to show models or photographs which do not truly represent the conditions existing, or to omit to cite the smallest detail in connection with the case or cases offered in proof or rebuttal of a theory, is not only unfair to those who conscientiously desire to learn the truth, but is the greatest impediment to progress.

Our essayist has quoted some of the misconceptions of the New School teachings which are held by a few prominent men in the dental profession, and has voiced the sentiment of his fellow workers in protesting against the persistent disinclination of the opponents of the New School to follow the progress it has made. The attacks seem to be centered principally upon the early teachings of the New School, while that which is offered to them through the later dental journals is ignored. Our essayist has cited several examples of this nature, as follows: One writer quotes from the sixth edition of Dr. Edward H. Angle's work to sanction the extraction of one upper bicuspid in a case of Class II, Division II, yet his apparent faith in that writer's teachings failed to interest him in the more recent publications which have appeared in the journals. Another critic of the New School will not divest himself of the idea that its followers aim to fashion unto an Apollo Belvidere all those coming under their care, and further misinterprets the New School principles with regard to the use of the intermaxillary force. Still another critic feels so strongly the great amount of harm which is being done to humanity by the New School coterie that he deems it his duty to openly protest against the successful efforts of these orthodontists in saving so many teeth from the hands of the extractor. He denounces them as "non-extractors" and then tries to make them out as untrue to their beliefs when the question "What shall be done with supernumeraries?" is answered, "Extract."

Through all these attacks the New School is diligently working, working, working, getting nearer and nearer to the time when all will see and believe; and when that time comes the question of which tooth to extract will be buried forever. Already the atmosphere shows signs of clearing. We see this in the tendency of orthodontists of the Old School to consider the facial lines in conjunction with the malocclusion and an endeavor to so mold the two arches of teeth that a perfect balance in the lines

of the face will result. The New School claims, and produces accurate models and photographs to substantiate its claims, that normal occlusion is accompanied by harmonious facial lines. It teaches definite means of correcting malocclusion, and gives a comprehensive classification of the types of malocclusion as a means of correct diagnosis. It is the only school that has successfully spread its principle and practice. What a contrast between that and the Old School, which offers nothing definite in the diagnosis, prognosis, or treatment. "Each case is a law unto itself," is the only definite doctrine that is preached. It can never be otherwise so long as the sacrifice of one or more teeth enters into the treatment of malocclusion. The New School is termed such with a ring of disparagement and scorn by many who claim it has given nothing new to the dental profession. They claim to have always understood what constitutes normal occlusion, yet in the same breath speak of extracting a lower central incisor in order to harmonize the sizes of the two arches of teeth. The conclusion must be that there is a New School and an Old School, differing in vital principles to such an extent that thought of conversion from one to the other seems almost hopeless. Yet this is precisely what is taking place. New supporters of the New School are springing up every year in large numbers, many of whom are from the ranks of the Old School. It will take many years to make converts of all, yet that time is coming just as surely as the years roll by.

Dr. W. O. Talbot, New Orleans, La.

In reading the literature of what is termed the New and the Old School, it seems to me there are two principal points of difference between them. First, and most important, is the difference in the ideas that practitioners of orthodontia have about occlusion. The New School holds that normal occlusion is the basis of the science of orthodontia, and therefore the ideal to be produced in the treatment of malocclusion; that by far the larger per cent. of all cases are amenable to such treatment, and when so treated the best possible results are obtained. The Old School does not accept these claims as true. They believe less in the importance of establishing normal occlusion, and therefore resort more to extraction to facilitate the alignment of the teeth in the arches; claiming that a larger percentage of cases may be so treated than the New School will admit.

The next point of difference is that of art. There is a difference of opinion as to what facial harmony really is. Where one of the older practitioners would deem it advisable to extract in Class II and bring the upper anterior teeth back, we would not consider it at all necessary, but would think it better to bring about a harmony in the facial line by moving the lower jaw forward. It seems to me that if we could agree on

these two principal points, there would be much less difference between the New and the Old School. It does not make so much difference as to the appliances that are used. If the two schools could get together and have an artist criticize our photographs and models of cases, as those were criticized last evening, it would cause many of us to see these conditions alike, and would help the dental profession to secure better results in the treatment of malocclusion.

Dr. H. A. Pullen, Buffalo, N. Y.

I wish to compliment the essayist on the great amount of work he has done in producing this paper. He has made it very plain that there exist two different schools of thought and method in orthodontia, which appear at the present time to be somewhat antagonistic. I do not wish to criticize the essayist any more than I would myself or any other member of the society who may assume the defense of the well-proven theories of occlusion, and the deduction therefrom, but I think it is the intention of the members of this society to refrain from unpleasant personalities, however much the heat of argument may otherwise incline us. As harmony is one of the very much beloved words in connection with out art, just so it should be one of the very much beloved words in connection with our relations with those who are seriously opposed to us in doctrine and practice. It is farthest from our thoughts to create offensive antagonism among those who have been designated as the "Old School." Dr. McKay has very favorably portrayed the points of difference between the "Old" and "New" School methods and I am sure, that, with no intention of personally offending any one, he has left no room for doubt as to the merits of the questions at issue.

Dr. C. M. Milan, Little Rock, Ark.

I recognize the fact that there is a right and wrong way open to you and me. Right antagonizes wrong. Antagonism precipitates conflict. Conflict results in death to wrong, increased life to right. I am always ready to be sacrificed fighting the wrong. Some old practitioners would rather die than be convinced of their errors and confess they had taught and practiced wrong. They will extract teeth because they have always so advised and practiced. They think their prestige forever gone should they confess to the public they were wrong. When I meet these old men who are so sensitive I am willing to let them be sensitive; just simply rub it in until it takes the hair off. (Laughter.)

Yes, we are a new school. We have walked out of darkness into light. For forty years I have refused to pull crowded teeth and some of my patients have gone around for years, as they say, "with a tusk sticking out," while others pulled them out. They have asked me why I refuse to pull them and I say, "God put them there and the devil or wrong

has been 'monkeying' with your mouth and I don't propose to disturb the devil nor have anything to do with him or wrong." Unless I can destroy the effect of the devil and remedy the wrong, I will leave it alone. (Laughter.) I live in Arkansas, too, and have pursued this course for forty years.

Dr. A. H. Ketcham, Denver, Colo. I want to say something about the extraction of the upper first bicuspid in the subdivision of the second division of Class II. Dr. Watson's remarks seem to leave the impression that it might be permissible when the cuspid is in labial occlusion where the patient did not have the means or the time to have the orthodontist treat the case. Now in those cases I think it is a great deal better practice to leave the tooth as it is, and tell the parents that some day they will probably have the means and time to have the case attended to properly. We all know that any country physician, dentist or veterinary can extract a tooth if it must be done, then the cuspid may settle back. Out in Colorado, if a person is poor to-day, but has the average amount of brains and industry, he will be in comfortable circumstances in a short time, and able to provide for the treatment.

Dr. Milton T. Watson. I did not for one moment advance my own judgment as to what should be done in this case. I merely brought up the point for the sake of argument that if in such a case the first bicuspid was extracted, we would not need to consider it as proof against the *wisdom* of retaining all the teeth. It is simply an emergency, in which a man's judgment might dictate that it would be better to extract than to do nothing.

Dr. Lloyd S. Lourie, Chicago, Ill. I take it that the profession in general will base their opinion of modern orthodontia on the published proceedings of this society, and if this paper, with its discussion, represents the ideas of this society as to what modern orthodontia is, we will let the discussion pass.

I believe that Dr. Watson has explained what exception we would take to Dr. McKay's paper, and my view would be to emphasize those remarks.

Dr. McKay's paper in so far as it criticized the methods of the Old School is perfectly just, but I do think his enthusiasm got a little the better of him in ascribing to them methods of treatment in hypothetical cases. I think that this correction should be made.

Dr. F. S. McKay. In preparing this paper my object was to state as strongly as I was able, what I considered a strong subject. My particular reason in stating it in such a manner was to draw the contrast critically between the present day

FIG. 1.

methods and teachings and those methods and teachings which have had their place and served their usefulness in times past; not for the sake of finding fault, but because of the attempt to perpetuate these theories and practices that have been proven to be erroneous and productive of harm. In reading the writings of our critics one can readily detect the underlying feeling, when the term "new school" is used, and if the imputation is not, that there is not, never was, and can not be any such thing as a "new school," then your essayist's judgment is all wrong.

The terms "full protrusion" and "full retrusion," I had hoped would be discussed by this society more fully. Your failure to discuss these terms leads me to the inference that they have no special significance to the "new school."

Report of Case From Practice.

Dr. E. H. Angle. I have a case of considerable interest to report, or rather it is the continuation of the report of a case which I presented in part at a meeting of this society three years ago in

FIG. 2.

FIG. 3.

Philadelphia. In regard to the case I at that time said (I quote from the transactions of that meeting): "Here is one case (Figs. 1 and 2 which represent the face of the patient before and after treatment) in which it may have been an error to have retained all of the teeth. It was so decided by Mr. Wuerpel, the eminent teacher of art, who says that the lips have been made too prominent, this being the only case of a large number examined that he has so criticised. Now we can see reason for his criticism. The lips are perhaps over-prominent to be in best balance with the rest of the features, but even here I believe I am right, for let us remember two conditions existing here, which dentists, artists, and 'old school' practitioners of orthodontia never seem to have considered.

"First, while the teeth are developed to full size, the development of the bones of the face is far from completion—the nose, the forehead, the chin, will all be different at maturity, and, I believe, in far greater harmony with the present sizes of the teeth.

"Second, the lips, in this case, are temporarily over developed by reason of a habit frequently contracted, especially in nervous patients, that of working the lips more or less constantly on account of the presence of the appliances in the mouth, thus tending, as in all muscles, to increase in size with increased exercise, but when the cause is removed they speedily

return to their normal size. I have noticed this in a number of cases. So I believe that in five years the correctness of my theory, namely, *that the best balance, the best harmony, the best proportions of the mouth in its relations to the other features require in all cases that there shall be the full complement of teeth, and that each tooth shall be made to occupy its normal position,* will be proven also by this case. If possible I shall at the proper time again publish the picture of this face."

It is, therefore, with much pleasure that I can to-day show you the likeness of this young lady as she appeared before the camera in January last (Fig. 3), and leave you to judge whether my prophecy has been verified.

An Accurate Method in Orthodontia.*

By C. A. Hawley, D.D.S., Columbus, Ohio.

At the Fourth International Dental Congress, at St. Louis, Mo., it was the privilege of the writer to read before the Section on Orthodontia, a paper entitled "The Determination of the Normal Arch and Its Application to Orthodontia," a paper in which was presented a method of accurately planning beforehand any proposed change in the form of the arch, or locating in advance the new line of occlusion.

The Line of Occlusion.

The line of occlusion has been defined by Dr. Angle as "the line of the greatest normal occlusal contact," and in the lower arch, passes over the crests of the buccal cusps of the molars and bicuspids and the cutting edges of the cuspids and incisors; in the upper arch it will be found along the sulcus, between the buccal and lingual cusps of the molars and bicuspids and across the lingual surfaces of the cuspids and incisors, about one-third the length of those surfaces from the incisal edge. The method referred to above, and which forms the subject of this paper, locates this line of occlusion directly in the lower arch. In the upper arch, it locates a line passing through the crests of the buccal cusps of the molars and bicuspids and the cutting edges of the incisors and cuspids and from this line the line of occlusion proper is easily found. In either case the line determines the shape, the width and the length of the arch.

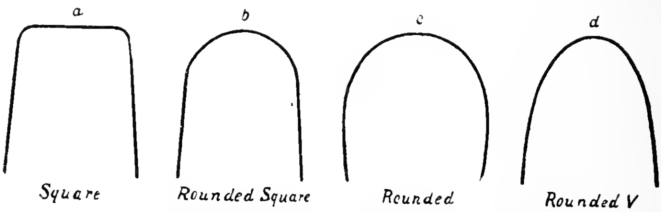
On the occasion of the presentation of the former paper and since that time, fears have been expressed that, in bringing into orthodontia a mathematically and geometrically calculated plan, we would restrict or eliminate the feature of artistic judgment, and that the method leaves no room for the exercise of judgment in changing the form of the arch to satisfy the requirements of the various types.

These fears or objections have been due to a misconception of the elasticity of the method in its application. In this paper, I wish to add something to the clearness of presentation of the method, and, in reply to the above mentioned objections, will make the proposition that, in so far as hampering, in any way, the use of judgment in the art requirements in orthodontia, this method lays down the most valuable principles and forms

* This paper is not a part of the transactions of the American Society of Orthodontists, but is appended at the request of a number of members.—*Editor.*

the most important basis upon which artistic results in orthodontia must be accomplished; and, instead of restricting the variation of the arch to correspond to different types, it forms the only safe guide for procedure in such variation.

The mathematical features of the denture comprised are in the occlusion of the teeth and the form of the arch or the line of occlusion. The normal occlusion of the teeth has been observed by Dr. Bonwill and



The main types of the dental arch

FIG. 1.

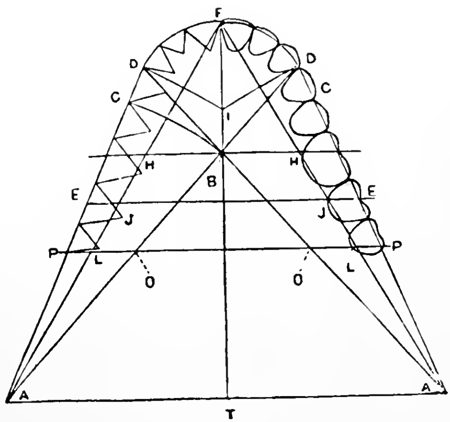


FIG. 2.

others, and has been made the basis of modern orthodontia by Dr. Angle. There remains no question concerning the normal and most desirable occlusion of the teeth or the desirability of restoring and preserving that occlusion, wherever possible.

The Ideal Form of Arch.

The ideal form of arch is determined with some difficulty and we might admit that there is no ideal arch for all cases. Dr. A. H. Thompson has made extensive observations of the form of arch in differ-

ent races and gives us the following typical forms: Fig. 1. "The square arch," he says, "is found usually in persons of strong osseous organization, of Scotch or Irish descent, *i. e.*, Gaelic extraction." * * * "The rounded square is the medium arch usually found in ordinary, well developed Americans." * * * "The rounded arch is quite characteristic in some races, as the brachycephalic South Germans." * * * "The rounded V is the arch of beauty and that most admired in women of the Latin races."

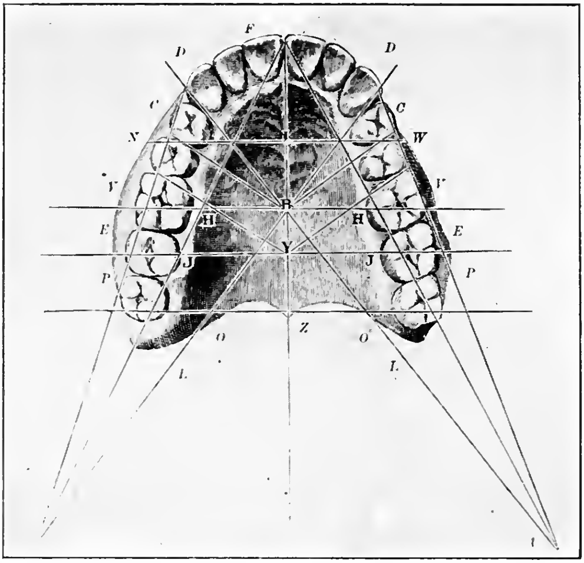


FIG. 3.

Dr. Bonwill, in his work on the Articulation of the Teeth, examined, as he says, 4,000 dentures in living persons and 6,000 skulls, and, from these observations established as a standard an arch based on the equilateral triangle and conforming closely to the most perfect arches found. This arch (Fig. 2) is not exactly the form of any of the types illustrated by Dr. Thompson, but seems to be a combination of the rounded square and the rounded V, as might be expected, when we consider that Dr. Thompson is presenting distinct racial types and Dr. Bonwill an ideal, selected from the most perfect dentures found in his investigations. This Bonwill arch conforms essentially to the typical arch illustrated in Dr. Black's "Dental Anatomy," as shown in Fig. 3, taken from the "Text Book of Prosthetic Dentistry," by Essig.*

* This conformity would be closer if the Bonwill diagram were correctly drawn. In the illustration, the triangle is not equilateral, the sides being longer than the base.

While Dr. Bonwill's efforts were, in the main, directed toward the application of his principles to the construction of artificial dentures, yet he seemed to realize their value in orthodontia, for he says, "The study of these laws will enlighten you in the true science of correcting irregularities." And if his work really disclosed the correct principles of the natural movement of the jaws, and this seems to be established beyond question, then any science of orthodontia that aims at broad and com-

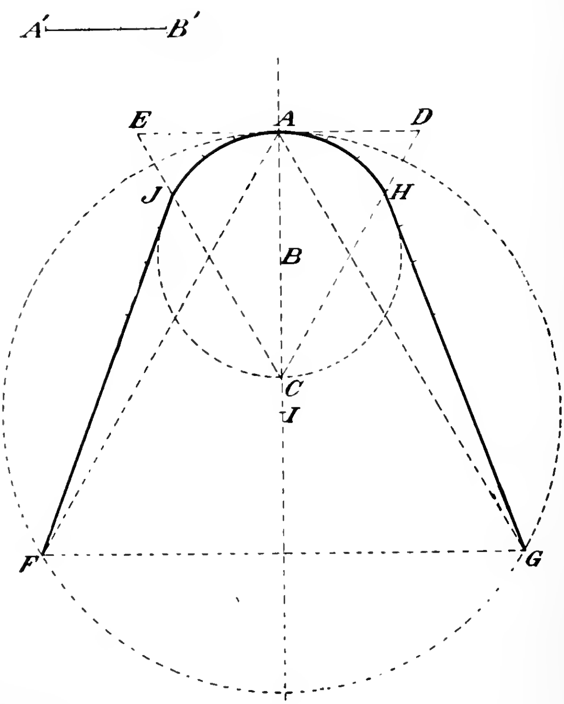


Fig. 4.

prehensive work must take into account these principles and produce in the living jaws the conditions that make their normal movements possible by establishing the normal occlusion of the teeth and the size and form of arch to correspond to the size of the teeth and the probable width between the condyles.

In Fig. 4, we have Dr. Bonwill's geometrical figure, an equilateral triangle, A F G, inscribed within a circle, its base F G representing the distance between the condyles, which varies in the living subject from 3 to 5 inches. According to his plan, in artificial dentures, the teeth are

arranged with the cuspids and incisors in the arc of the circle A J C H, the size of which varies according to the size of the teeth selected for the case, and this selection is left to the judgment of the operator.

In order to use this principle in orthodontia, where we have the size of the teeth given us, and from their widths the diameter of the circle A J C H, we must reverse the order of procedure and find a connecting relation between this circle and the equilateral triangle A F G, or the circle within which it is inscribed. This connection is not described in

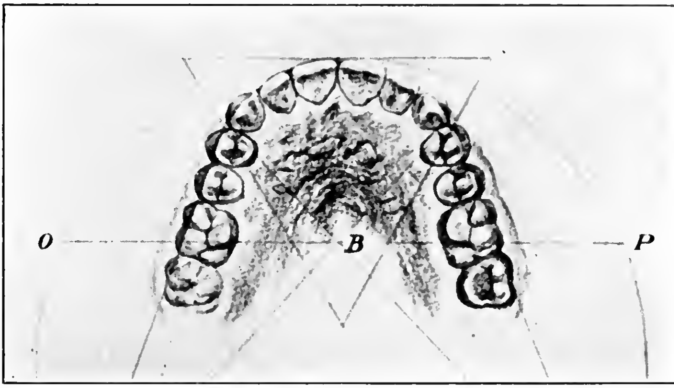


FIG. 5.

Dr. Bonwill's writings, so far as I have been able to find. It is found in the triangle E D C, constructed with its apex at the point C, on the diameter of the circle A J C H, and its base tangent to the same circle at A, the sides passing through the points J and H, located on the circle by the distance of the radius from A.

Mode of Making the Diagram.

In application, to construct the diagram, we take the radius of the circle A J C H from the combined widths of the central lateral and cuspid teeth shown at A B. With this radius A B, upon the line A C, which becomes the extended diameter of the circle, draw the circle A J C H and, with the point of the compass at A, mark off the radius upon the circumference at H and J. We have here the arc of the circle upon which the six front teeth are to be arranged, but know nothing of the size of the triangle A F G. From C draw the lines C E and C D, through H and J, extending them indefinitely and draw a tangent to the circle A, cutting these lines at E and D, and forming an equilateral

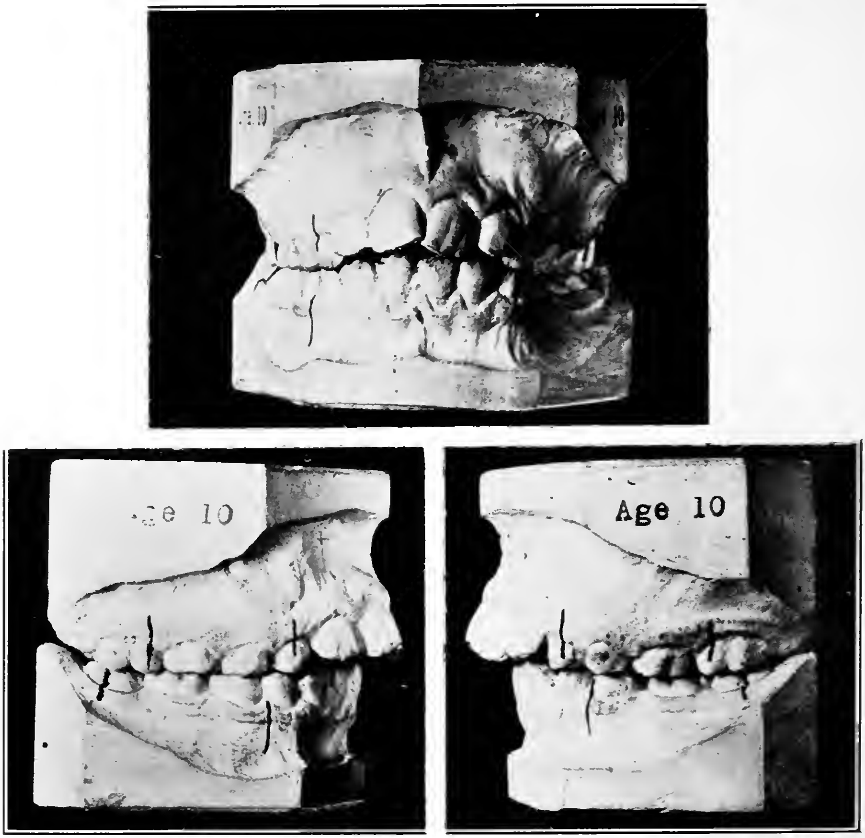


Fig. 6.

triangle E C D. Take one side of this triangle as a radius and with one point of the compass at A, and the other upon the extension of the diameter at I, describe the large circle A F G. We can now mark off the radius six times on the circumference of this circle and, connecting the intervening points, draw the triangle A F G. Then draw the lines F J and G H and we have the desired diagram or arch upon which we may measure off the teeth with the width as found in the mouth.

The teeth can then be drawn in full, as shown in Fig. 5, which is the plan I adopted in my first working with this method, or the single arch line can be used. The former method was of great advantage to me at first, giving a better view of the completed work.

Mode of Using the Diagram.

My present method of working is shown in the following case: Class II, Div. I, Age 10, of which Fig. 6 shows front and side views. The deciduous molars and cuspids are present. The method of calculating this arch will be explained later. Fig 7 shows the occlusal views of both upper and lower teeth. The arch is transferred to a piece of transparent celluloid* and by placing this in proper position on the model, every movement necessary to correct the case is accurately shown.

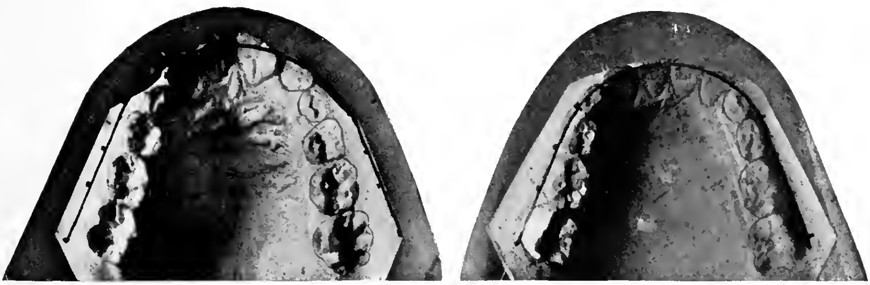


Fig. 7.

Fig. 8.

Also the shortening of the arch is shown and this is very valuable in calculating the effect of the proposed movement on the outlines of the face.

I wish to call your attention here to the small degree of expansion indicated in the lower, compared with the upper, jaw. In this type of cases, this fact indicates that the narrowness of the upper jaw has forced the lower backward, as the causes which operate to narrow it do not obtain in the lower and it seeks a distal position in order to obtain a com-

* The use of a transparent substance was first suggested to me by Dr. L. P. Bethel. All the illustrations which show the diagram of the arch are slightly vague because the models were photographed with the celluloid diagrams in front of them.

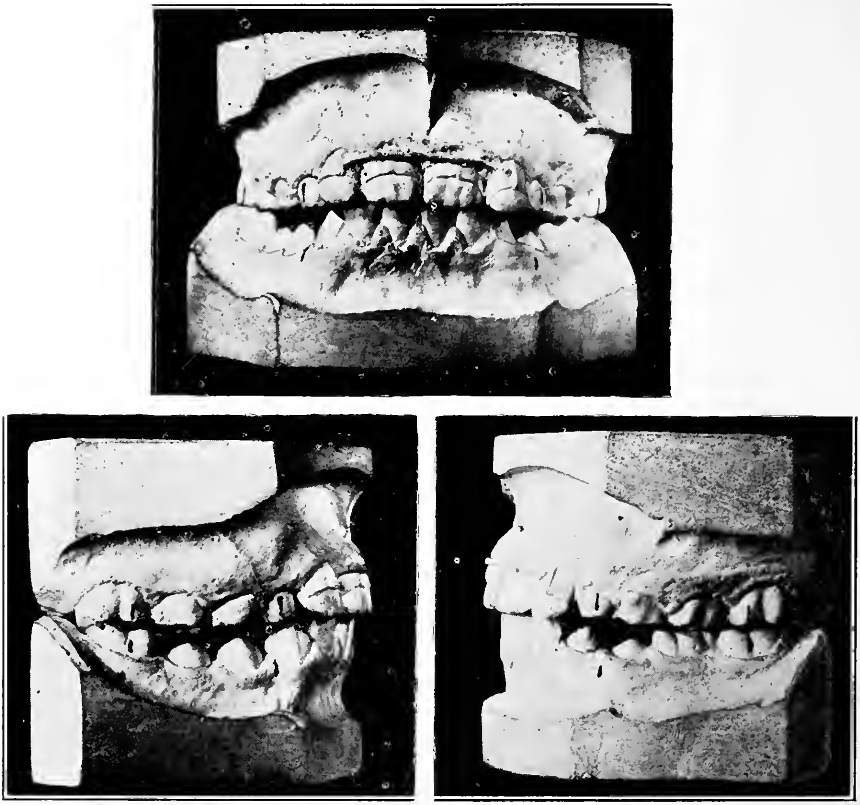


Fig. 9.

fortable occlusion. Thus the condyles are carried back to an abnormal position in the glenoid fossa. This is indicated, too, by the fact that frequently when the upper arch is widened, the lower comes forward easily and never requires mesio-distal retention more than that furnished by the cusps of the molar teeth. This fact was brought forcibly to my attention by the study of cases of this kind with the diagrams. The diagram is used in the progress of the case as a constant check on the movement, measuring in the mouth with compasses, from time to time, and comparing with the diagram. Or if one wishes, the celluloid can be placed in the mouth at any time and the positions of the teeth noted there directly. Fig. 8 shows the occlusal views of this case finished, and Fig. 9 the front and sides.

In the next case (Fig. 10), the upper molars are in lingual occlusion, and the question would arise (Fig. 11) as to whether the lower

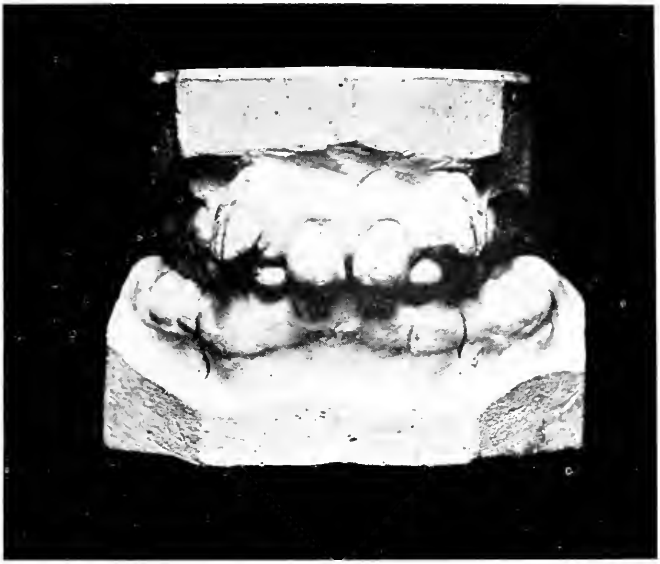


FIG. 10.

FIG. 11.

molars had been pushed outward. The shortening of the arch and the absence of the second molars give that appearance. But (Fig. 12) the diagram shows that this is not true, and indicates the desired movement in both arches. Fig. 13 shows the completed arches and (Fig 14) occlusion of the finished case. These two cases I will consider sufficient to illustrate the method of work.

Fig. 12.

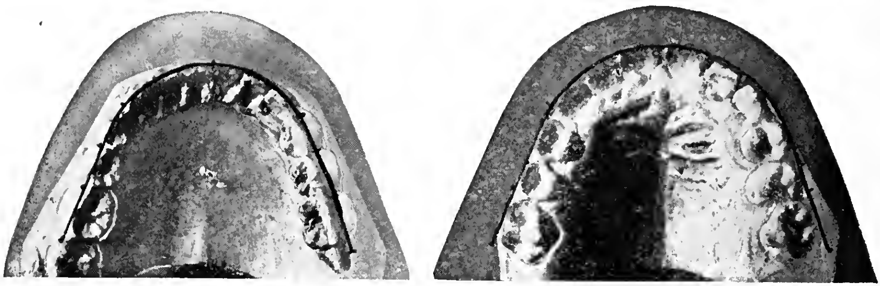


Fig. 13.

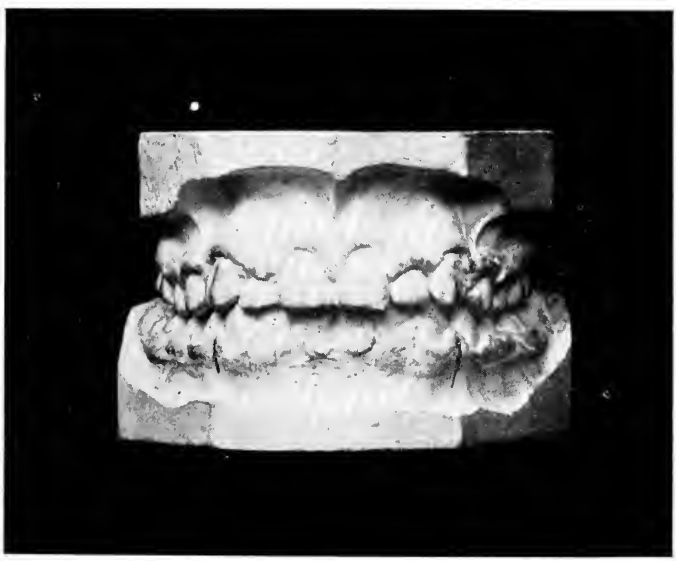


Fig. 14.

The Bonwill Arch. I did not formerly, nor do I now, wish to be understood as insisting on this form of arch in detail in every case. If a uniform arch were to be adopted, this one of Dr. Bonwill's would undoubtedly be the nearest adapted for universal application. It is a standard, capable of being produced by exact geometrical and mathematical rules, and conformed to any size of teeth. Without, myself, at this time discussing the question of how closely we

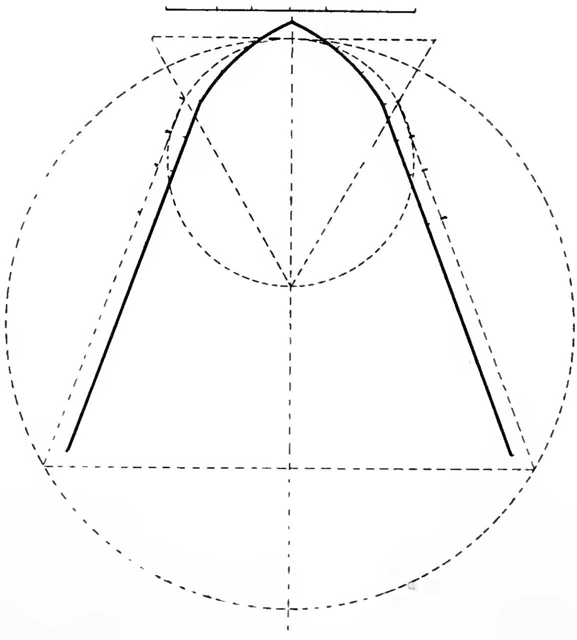


Fig. 15.

should conform our work to this arch in all cases, I wish to quote for your consideration the opinion of Dr. William J. Brady in a paper entitled, "Some Points Concerning Occlusion," read before the American Society of Orthodontists, at St. Louis, June 12, 1901. Referring to the Bonwill arch, he says: "The fact is, that if nature were not thwarted in her purpose, every dental arch would be upon these perfect lines. The mechanics of the case compel an arch of this form to permit of the highest usefulness and the mechanical forces of mastication produce this arch as nearly as possible. Even in malocclusion the teeth follow this perfect form just as much as the mechanics of the case admit. The mechanics of the case demand an arch of a certain definite form, because of fixed and unchangeable laws, and not because somebody thinks it ought to be that way

or because it makes a pretty diagram on paper. As long as the jaw comprises an equilateral triangle, and rotates upon one condyle at a time, when moving laterally, just so long will this form of arch be the one unvarying end that nature tries to attain in her way, and the one final result that we should seek in our work. Until the lower jaw changes its form or its motion, all men will (or should have) arches of the present form, and race, color, temperament or hobby, fad or ism will not change the facts in the least."

My own argument, at this time, is for its use as a standard, a basis of diagnosis and study and the accurate and systematic planning of the work, estimating beforehand what we wish to accomplish, and working quickly and accurately to that end. We should not attempt to change the form of any arch without a definite end in view. It will greatly lessen the discomfort to the patient and the time for the operation. In my own work, in the study of cases, and as a guide in their progress, this method has been invaluable.

Variation of the Arch.

To illustrate a plan of making variations from the standard arch, we will refer to Fig. 15, where we have the standard Bonwill arch and a pointed arch drawn from it. The Bonwill arch represented is the arch for the size of teeth in the case. If we wish the pointed arch to be one quarter of an inch narrower, we draw the lines for the molars and bicuspids one-eighth of an inch within the standard arch on each side. The narrower arch will necessarily be longer than the Bonwill, and here we have the choice of carrying the molars backward and leaving the lips stationary or of leaving the molars in their place and carrying the lips outward. Similar calculations could be made for a wider arch. We may thus make calculations for any type and any temperament, and this accurate calculation lays a safe foundation for artistic results in orthodontia. This foundation also opens the way for a scientific examination into the question of types and temperaments, in their relation to the teeth, a question about which we know little that is of value.

By restoring normal occlusion and a form of arch in harmony with the size of the teeth, that will admit the natural movement of the jaws, we will thus, so far as the mechanism is concerned, obtain the natural development of the denture. And in retention, we will guard most effectively against any final retrogressive changes that might take place, by conforming the arch to the natural mechanical forces of the jaws. From the artistic side of the question, while nature may not, in all cases, have furnished teeth exactly adapted to the individual, yet in the present development of orthodontia, the hypothesis that she has is a safer basis of work. For, when we consider all the evils of extraction as set forth by

many men and especially by Dr. E. A. Bogue, we, indeed, must hesitate to trust our conceptions of improvement by mutilation, as compared with the utility of the denture when the teeth are placed where nature intended they should be.

Tooth Measurement.

So far, in dealing with this subject, we have presumed that the centrals, laterals and cuspids were erupted or that the denture was practically completed. But to be scientific and progressive, orthodontia must assume an attitude of prevention in early life. This necessitates a recognition of dwarfed and abnormal conditions as soon as they appear. Very early in the use of this method, I found that in a large number of cases coming into my hands, the necessary data could not be obtained. Most often the cuspids were unerupted, and, in many cases, the laterals also. My first recourse was to measure the central incisor, then refer back to a case previously treated, having a central of the same width, and, presuming that the teeth were always in proportion, use that arch. This method was adopted in the case illustrated in Figures 6, 7, 8 and 9. While furnishing a fairly accurate guide, the variations that were at once apparent led me to enter into an investigation of the proportionate widths of teeth, as they occur in the same mouth, with the object of establishing a series of approximate arches for use in young patients. For this purpose, I have collected measurements of over 100 sets of teeth,* using the following forms:

Collection of..
Model No.................................
Sex ....
Age.....................

Upper.		Lower.	
Right.	Left.	Right.	Left.
Cent	....	Cent	....
Lat	....	Lat	....
Cusp	....	Cusp	....
1st Bic............	....	1st Bic............	....
2nd Bic............	....	2nd Bic............	....
1st Molar..........	....	1st Molar..........	....
2nd Molar.........	....	2nd Molar.........	....
3rd Molar.........	....	3rd Molar.........	....

Width of Original Arch................
Width of Expanded Arch..............

* In this work of collecting measurements, I have received valuable assistance from Drs. E. H. Angle, Frederick McKay, J. L. Young, Herbert Pullen, L. P. Bethel and Walter Ellis.

Dr. Black, in his "Dental Anatomy," has published a table of measurements of the teeth, in which is found the extent of variation in their mesio-distal width, but without reference to their variation in the same mouth. Selecting these measurements, we have:

Central Incisors	.31	to	.39
Lateral Incisors	.19	"	.29
Cuspids Incisors	.27	"	.35
First Bicuspids	.27	"	.31
Second Bicuspids	.23	"	.31
First Molars	.35	"	.47

It will be noticed that, with the exception of the first bicuspid and first molar, there is a uniform variation of 8 points, the first bicuspid making 4. one-half that amount, and the molar 12. These measurements do not represent the greatest extremes, but those occurring outside these figures are rare. Now, if the teeth were found in the mouth in the same proportion in respect to their greatest and least width, that is, if with a .31 central, we would find a .19 lateral, a .27 cuspid, .27 first bicuspid, .23 second bicuspid and .35 molar, and so on with each size of central, we could make out the radius of each size central and from these draw proportional diagrams. But such is not by any means the case. With a .31 central, we often, in fact usually, find a lateral .26 or .27, and the cuspid may be quite small or well up in the scale, or we may have a central and lateral in good proportion and the cuspids much larger. In order to discover the nature of this variation, I selected from the 100 measurements all the cases of each width of central, and made of each of them a table. The number of cases of each size central was .31—15, .32—7, .33—16, .34—16, .35—9, .36—14, .37—13, .38—5, .39—2. A number of the 100 cases I was unable to use, on account of missing teeth or so great variation as to question the accuracy of measurement.

Collecting each of these sets, I have nine tables, of which this one of the .35 central is an example:

Central	Lateral	Cuspid	1st Bic	2d Bic	1st Molar
.35	.24	.31	.27	.27	.41
.35	.28	.31	.29	.30	.41
.35	.25	.30	.25	.25	.42
.35	.28	.31	.28	.27	.42
.35	.27	.33	.29	.29	.44
.35	.24	.30	.30	.28	.41
.35	.28	.33	.29	.26	.40
.35	.26	.30	.27	.27	.43
.25	.27	.32	.27	.27	.41
Average:					
.35	.27	.31	.28	.27	.42

Taking the average of the widths of the other teeth, I have the average width of teeth that will occur with each width of incisor and from these averages the average radius which will give us the probable arch for each size central.

Cent'l	Lateral	Cuspid	1st Bic	2d Bic	1st Molar	Radius	Corrected radius
.31	.26	.29	.26	.26	.39	.86	.86
.32	.26	.30	.27	.26	.40	.88	.88
.33	.27	.30	.28	.27	.41	.89	.90
.34	.28	.30	.28	.28	.42	.92	.92
.35	.27	.31	.28	.27	.42	.93	.94
.36	.28	.32	.28	.28	.42	.96	.96
.37	.28	.32	.30	.29	.42	.97	.98
.38	.28	.34	.30	.29	.44	100	100
.39	.31	.34	.31	.29	.44	104	102

In the last column I have placed what I will call the corrected radii, in which we get an ascending gradation. I wish, at this time, to point out the nearly uniform gradation of the first molar and later refer to its significance. Now, taking these corrected radii, we will get an arch for each width of central and I will propose these as a basis of diagnosis, study, and treatment of cases where only part of the teeth are erupted, or under the age of 12. Or using the radius in hundredths of an inch for comparison they may be used as a guide for all cases, for where we can measure all the teeth we have only to select the diagram with the correct radius, and measure in the teeth. Remembering that these arches are only averages and smaller or larger teeth will constantly occur in connection with the particular central, is there any indication by which we can judge in which direction this variation will occur, *i. e.,* toward smaller or larger teeth? I think we have this in the first molar and this tooth is always present at the time of the eruption of the central incisor. As the first molar varies up or down from the average width, I believe the rest of the teeth will vary. For instance, we will suppose we have a case in which the central incisor is .34 and the first molar .42. If I had a second case with the same size central, but with the first molar .44, I would presume that the lateral and cuspid and all the rest of the teeth would be likely to be large and would select the next larger arch. In this way I think we have the key to a pretty accurate judgment of the future denture. In making up these averages, I have tried to err, if at all, on the side of the larger arch, believing if we do get the arch slightly larger than the teeth will fill, if it is properly shaped and the teeth are placed in normal occlusion, as the excess will, at the worst, be only a few hundredths of an inch, the pressure of the cheeks and lips, the influence of the occlusal planes and the

pressure forward of the second molar in eruption will close the spaces. Nature has given us an example of the wisdom of this provision by making the combined widths of the temporary molars considerably more than that of the bicuspids, which are to take their places.

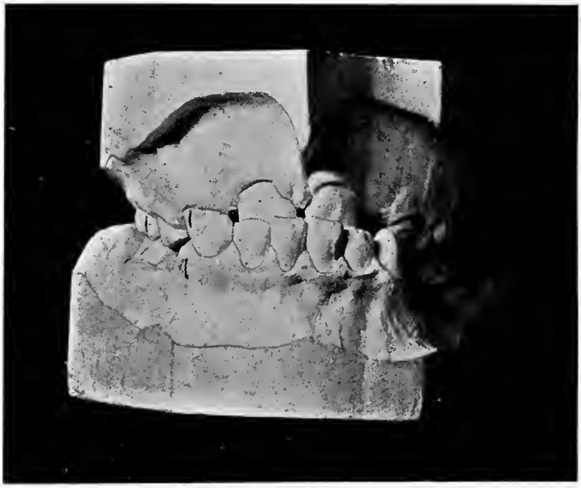


Fig. 16.

Fig. 17.

Similar tables were made for the lower teeth, and the result makes it evident that the uniformity of lower arches, drawn from the measurements of the lower incisors and cuspids, is not to be depended upon. While the lower bicuspids and molars are fairly uniform in their relation to the upper, within the same mouth, the incisors and cuspids are not.

This lack of uniformity is probably compensated for in the inclination of the teeth and the overbite. Without discussing these variations at length, I wish to advise that instead of drawing the lower arch from measurements of the lower teeth, as described in my former paper, the radius for the lower be taken from .13 to .23 of an inch shorter than the upper, de-

FIG. 18.

FIG. 19.

pending within this variation on the size of the teeth or the distance from the line of occlusion to the crest of the buccal cusps.

In illustration of my use of these arches, let us take the case of a child

eight years of age, Fig. 16. We have here erupted of the permanent upper teeth, only the central incisors and first molars, and in the lower the centrals, laterals and first molars. All of the deciduous molars below have been extracted and the first deciduous molars above. The arches are consequently contracted, especially the upper, in which the centrals are in lingual occlusion. The centrals are .33 wide and the molars .37, while the average molar for that diagram is .41. As the molar is small, I judge we are likely to find small laterals and possibly bicuspids, as these are the teeth that vary most, so I would select no larger arch than that for .33.

FIG. 20.

I chose to develop this arch to the largest safe point, because the child has had an operation for the removal of adenoids and needs all the development of the nasal passages possible. Fig. 17 shows the development of the arch that will be necessary.

In Fig. 18, we have another case, also a child of eight, in which the occlusion is developing into distal. Fig. 19 shows the occlusal view of the upper teeth. In this case we have a .38 central and .42 molar, while the scale gives us a molar .44, so we will use the .38 arch and expect fully developed teeth.

It might be argued that it is unnecessary to widen this arch with the temporary teeth at this time; that the natural growth of the jaw will be sufficient to make room for the teeth. But you can not place the incisors in alignment without either widening the arch or placing them considerably forward of their proper position. If the whole arch is widened, the

crowns of the developing bicuspids are carried with the temporary molars and the chances of their erupting in malocclusion is greatly lessened.

In regard to the question that may arise as to whether the first molars, when they erupt, should normally be in their proper bucco-lingual positions, the study of cases by this method leads me to believe that they should. Notwithstanding the fact that few children have been brought up under conditions where the teeth have been properly and normally used,

FIG. 21.

yet I have found enough cases where they have erupted in their full bucco-lingual width, to, I think, justify me in the above conclusion. One of these, a boy of seven, I will show in Fig. 20. Fig. 21 shows the occlusal view. The incisors are .34 wide, the molars .44, which is .2 larger than the average, and are in their correct bucco-lingual position, as is shown by the diagram.

Enough has been shown to illustrate this method and allow you to judge of its value. There are many other interesting points in connection with these measurements that may prove valuable, but their discussion is not within the limits of this paper.

Again, in conclusion, as to the matter of types, without raising the question here as to how much variation is required in the different races and temperaments or whether such variation is desirable at all, or as to whether we are not safer in our present knowledge on the subject to sacrifice a possible improvement in artistic effect, to greater utility, by conforming to the Bonwill arch; without discussing these questions, I will say that the only safe basis upon which to make such variation is a carefully calculated arch from these measurements. And as to variation for

artistic effect of any kind, as mathematics is the basis of architecture, music, painting and all the arts and sciences, so I believe will these principles underlie the best that we will accomplish along these lines in orthodontia.

It is perhaps unusual to present a paper on a subject pertaining to orthodontia, without any reference to appliances, but I have little to say

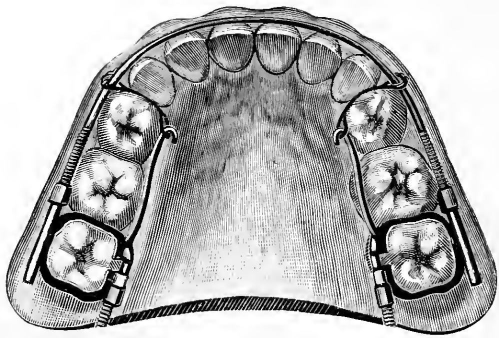
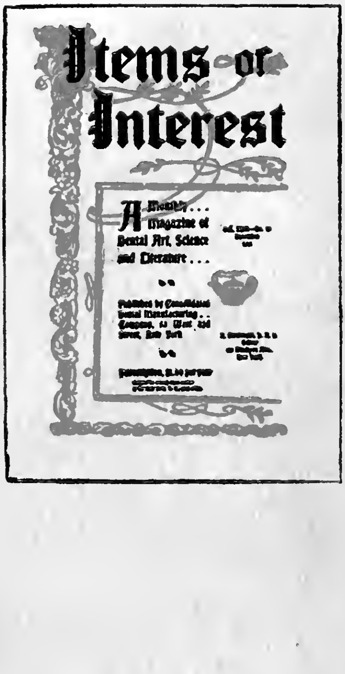


Fig. 22.

on that subject at this time. The only appliance that I have used, with which I could have the necessary control of all the teeth, is the expansion arch. There is just one point in using this appliance, that may be essential to the argument of the paper. In moving the temporary molars and cuspids we find their great constriction at the neck and the consequent abrupt slope of the enamel allows the ligatures to work under the gums too far and cause irritation. To obviate this trouble, I reverse the clamp bands on the second temporary molars, where possible, and carry a wire along the lingual surface to the cuspid. It is soldered to the clamp band at the mesio-lingual angle shown in Fig. 22, on a model in which the clamp bands are on the sixth year molars, and the lingual wire is extended only to include the two temporary molars. The principle is, however, the same. With this lingual wire in place, we have only one ligature necessary on each side and the wire holds so that it can not slip down upon the gums. This arrangement is also valuable in many cases of fully erupted dentures.

Note.—Fig. 22 is incorrectly drawn. The D bands should be on the temporary molar, with screw left long and touching the sixth year molar. The ligature wire should be mesial of temporary cuspid.—*Editor.*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